Electrical Review

With Which Is Consolidated WESTERN ELECTRICIAN and ELECTROCRAFT.

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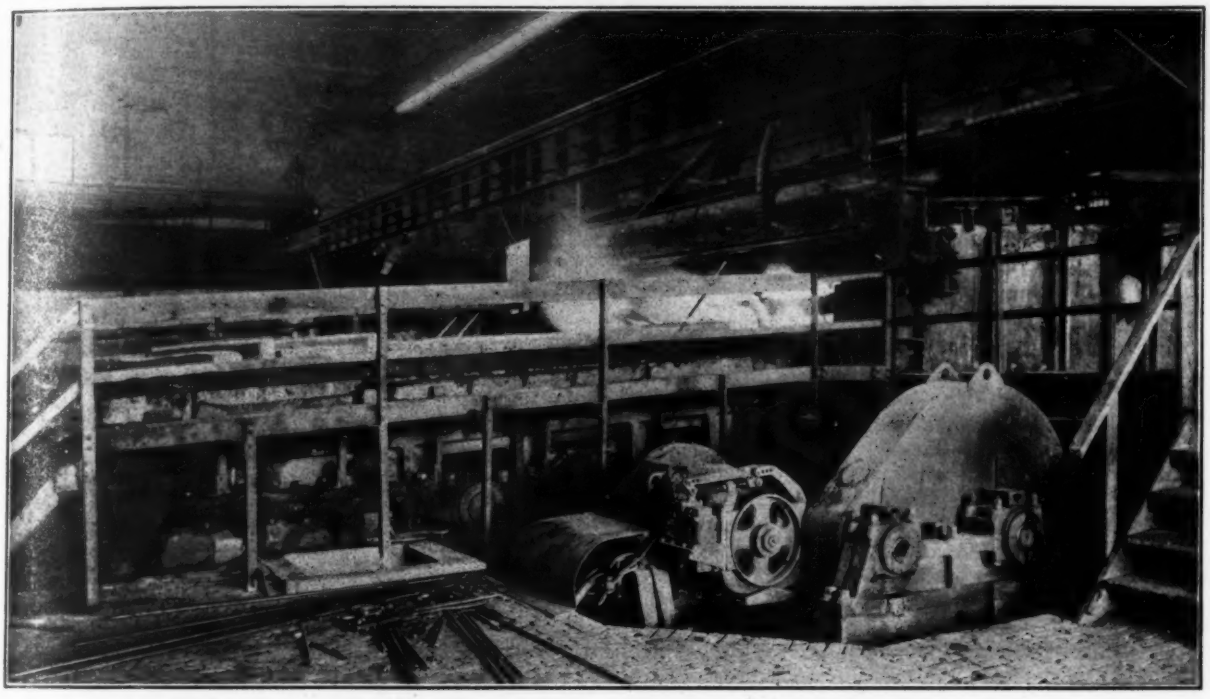


75-Horsepower Motor Driving Feed Table in Steel Mill.

Motor Drive in Various Industries

A Discussion of the Advantages and Operating Characteristics of Electric Motors in a Number of Important Industries Affected by the War—Other Industries Will be Discussed in the Next Issue

IN THESE days, when virtually all industries are making strenuous efforts to keep production somewhat commensurate with the demands, electric motor drive is demonstrating its many inherent advantages. Manufacturers who previously paid little or no attention to the economies to be derived from complete electrification are finding that the claims of the central-station power salesman and motor manufacturer are fully justified. The result is that the problems of motor application are today of national importance.

The specific advantages of electric drive which are emphasized by existing conditions are increased production, reliability and uniformity of product. There are, of course, many other important advantages, such as space economy, reduced fire risk, flexibility in arrangement of machines, etc., which must be given consideration but which vary in importance, depending upon conditions in the various industries.

One of the most important phases influencing the successful conduct of any manufacturing establishment is the amount of output obtainable with a given personnel, tool equipment, floor space and working time. Without increasing any of these factors the substitution of electric motors for mechanical drive has augmented the productive capacity of different shops from 5 to 100 per cent. In other words, a greater amount of work is produced per operative machine per day, due to maintenance of speed under varying conditions of load; the ease with which the maximum speed can be maintained throughout a given operation; the advantage gained by better arrangement of machines in regard to natural or artificial lighting, as well as in the readier access to and sequence of material from the unfinished to the finished state, etc. In modern establishments, high productive capacity will hinge largely on the convenience and rapidity with which work may be handled. Therefore, costly high-speed tool equipment may fail to realize possibilities unless the machines be installed with independence from the

usual fixed lineshaft conditions. In shops where productive machines are widely separated, one from another, or where occasional machines must be reached by long lines of shafting, individual motor drive will effect many economies.

While increased production is obviously the most important result attained by the installation of electric drive, it is also true that direct economies are frequently effected in power costs, particularly where central-station service is employed.

On the following pages we present data on the application of electric motors to a number of industries which have been more or less directly affected by the war. The specific advantages that apply in each industry are discussed and operating data given wherever possible.

Iron and Steel Mills

THE economical production of iron and steel, either in the shape of ingots or manufactured articles, is a matter of national importance. It is, therefore, not strange that the subject of electric drive for steel and iron mills has been given a vast amount of attention.

Motor drive for the auxiliary apparatus of steel mills, including tables, screw-downs, cranes, charging machines, etc., has been used for about 20 years. The application of motors to the main rolls, however, is a comparatively new step but one which indicates great possibilities for the future. The popularity of electric drive, while it does not mean that its superiority over steam driving is generally established, certainly shows that there are a great many cases where the motor is found to be preferable.

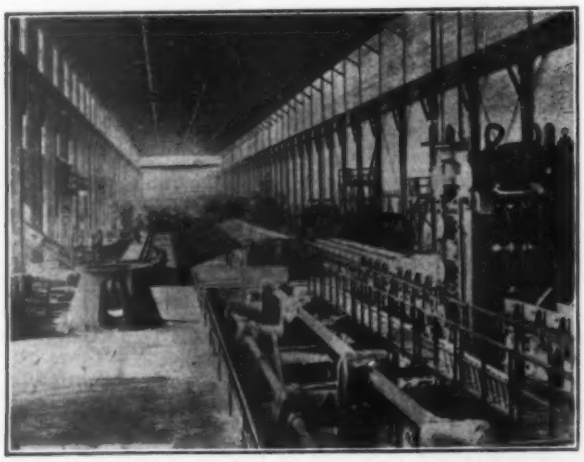
The comparisons between steam and electrically driven mills should naturally be expressed in dollars and cents but unfortunately there are hardly any specific figures as to the coal consumption of steam-driven mills, while there are available considerable data by which the power consumption of electrically driven mills can be determined with a fair degree of accuracy.

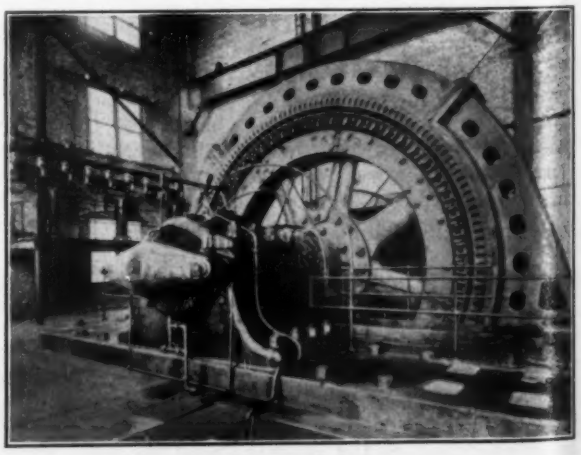
The difficulty of obtaining reliable information about the consumption of steam-driven mills lies in the excessive cost and complexity of the necessary tests. While electric motors do not differ much in efficiency, the coal consumption of steam engines varies in extremely wide limits so that test data obtained on steam-driven mills cannot be generalized to the same extent as that obtained on electrically driven mills.

In most cases waste-heat boilers, which are supplemented by slack-fired boilers, supply the steam for the rolling-mill engines. The portion raised in the waste-heat boilers is not infrequently said to cost nothing, and a motor, taking the place of the steam engine, is expected to have a current consumption costing less than the slack burned under the supplementary boilers. To expect this is very unfair, and the mistake lies in the assumption that steam raised by waste heat does not cost money. The fact is that waste heat must be paid for very heavily, and modern practice shows that it is advantageous to replace the waste-heat reheating furnace by a regenerative gas furnace, and the steam engine by an electric motor. The latter is true, at least in such cases where properly superheated high-pressure steam cannot conveniently be obtained from efficient boilers or where the connecting-up to an efficient condensing plant is impossible or costly. Coal-fired waste-heat furnaces require about 0.4 ton of good coal per ton of iron reheated, and if equipped with high-class boilers, it is possible to raise with the waste heat of such furnaces about 1.8 tons of steam at 100 pounds pressure per ton of iron reheated.

The use of steam engines for driving the main rolls is restricted by the location of the mills, and to reduce the loss in piping the distance must be as small as possible. Everyone familiar with the difficulty of maintaining steam piping tight and properly insulated will appreciate the necessity of reducing the length.

In large plants it has been found necessary to use two or more boiler plants, which naturally increases the first cost, as it means a duplication in equipment and also increased labor and supervision. It is extremely difficult to obtain any reliable figures as to the loss in piping as local conditions affect the results so much as to make the figures obtained useless unless such conditions are considered. In some tests made in a mining plant it was found that in 600 feet of 18-inch piping through which 120,000 pounds of steam, with an initial pressure of 145 pounds per square inch passed per hour, the average temperature drop was from 440 degrees Fahrenheit to 395 degrees Fahrenheit and the pressure drop was about 12 pounds. From the above it will be seen that the steam had a superheat of 76 degrees Fahrenheit. The pipe was insu-





Motor-Driven Finishing Mills and 6000-Horsepower Steel-Rolling-Mill Motor at Gary, Ind.

Motor-Driven Bending Rolls and Plate-Punching Machines in Shipbuilding Plant.

lated and was in what was considered good condition. The above corresponds to a loss of 3,600,000 British thermal units per hour, corresponding to 22 per cent of the available heat in the steam. In another case there was a 12-inch pipe 340 feet long on which the insulation was rather poor, carrying 157,000 pounds of steam in 24 hours. The initial pressure was 120 pounds per square inch, the steam being saturated. The loss through condensation in 24 hours was 22,000 pounds, equal to 14 per cent of the total. Inquiries made from the operators of a number of plants indicate that the average loss in piping is about 15 per cent, although some mills show very much higher figures. From the above it is obvious that in practice the losses are very great and that the steam piping can only be considered a necessary evil and should be reduced as much as possible.

These conditions naturally emphasize the advantage of electric drive.

The increasing use of electric motors for driving the main rolls in modern steel works makes the question of the power requirements of rolling mills of considerable importance. However, it is hardly possible to obtain reliable information from published data, and rolling-mill practice is wholly based upon knowledge gained by experience. One of the most difficult problems is to determine the set of conditions on which to design the equipment. A great many superintendents are of the opinion that it is impossible to obtain, within limits, an equipment too large. This is a mistaken idea based upon past experience.

The size of the mill as determined by the size of pinions, or the width and diameter of rolls, has comparatively little to do with the size of the motor required for driving it, as the work performed by the same size mill may vary several hundred per cent. The fundamental basis on which the size of motor must be determined is the product of the mill and the tonnage rolled. There are a great many factors entering into the proposition which must be considered. Dealing first with the product, the following are the principal in their usual order of importance: volume of metal displaced; method of displacement; temperature of metal; class of material; rate of displacement; and size of roll.

The great majority of rolling mills are of the type running continuously in one direction, and to equalize the input to the motor flywheels are used. It is of the greatest importance to determine the size of flywheel required in conjunction with the characteristics of the motor and control apparatus, as it is only by considering them as a unit that a satisfactory installation can be made. With the ideal flywheel, a motor sufficiently large to carry the average load would be the right size to use, as all the peaks would be taken by the flywheel, and during the intervals between passes energy would be stored in it. In practice it is not possible to use such flywheels, as they would be excessively large, and consequently a compromise must be made between motor and flywheel. It is usual to consider that the mill will run for short periods at its maximum capacity, that is with the minimum interval necessary to handle the material, and on this basis the load diagram must be determined. The load diagram can be determined from curves showing the power requirements per cubic inch displacement, in conjunction with the volumes displaced and the rate of rolling. From this diagram, the average load when the mill is rolling at the maximum rate can be determined, and also the size of the flywheel. The average production of the mill must be taken into consideration in determining the size of motor, so as to have an equipment which has suitable characteristics for the normal operating conditions.

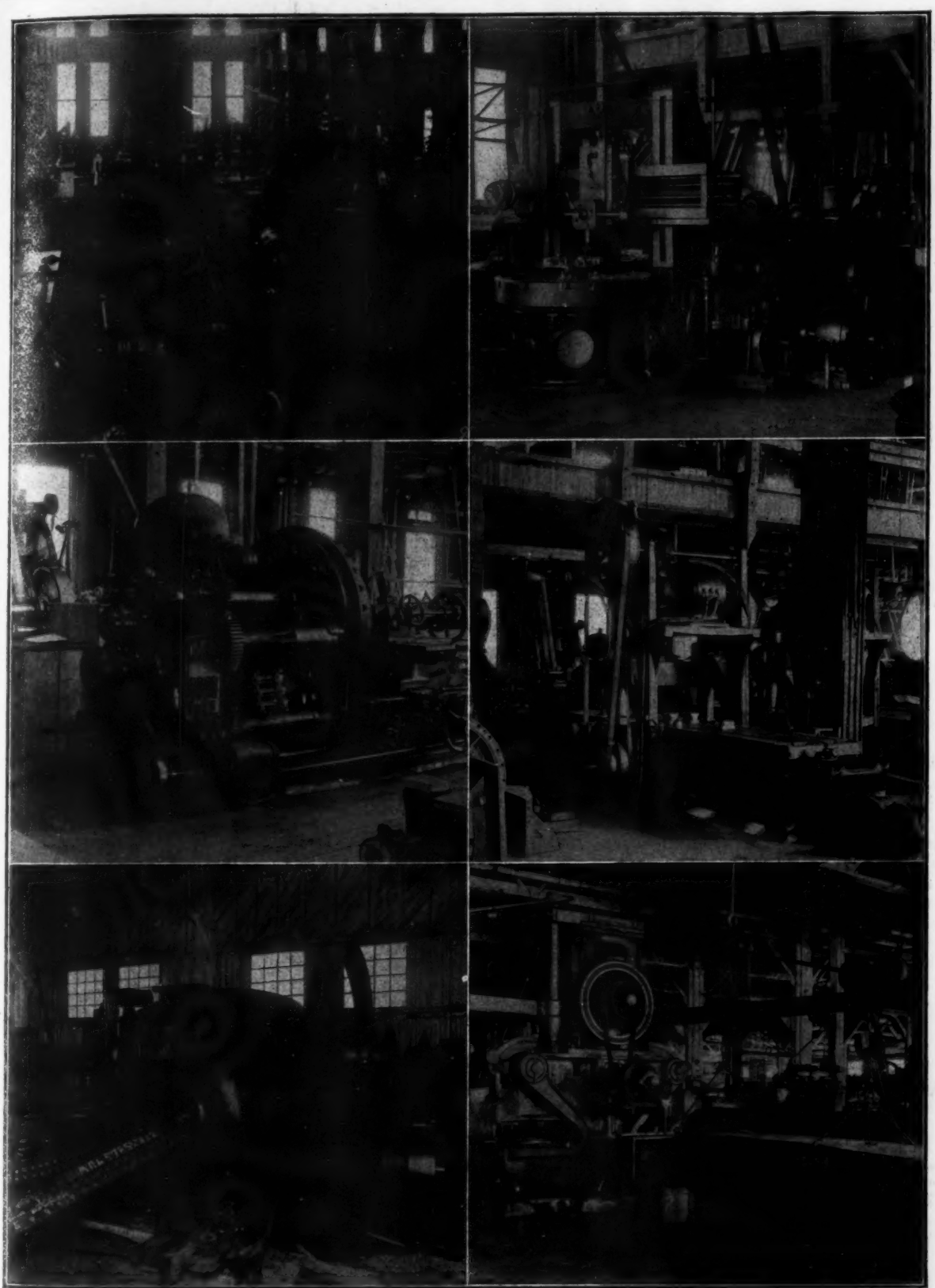
Motor drive for the auxiliary apparatus of steel mills has been used for about 20 years. The application of motors to the various machines, such as tables, screw-downs, cranes, charging machines, etc., was naturally a very gradual process. The conditions were very unusual, as the work was of an extremely severe nature, requiring frequent starting and stopping, rapid acceleration and sudden stops. Motors had to operate in very hot and dirty places and in a majority of cases gear drive was used. The mills were operated for 24 hours a day, six days a week. The manually operated direct rheostatic controller was the only type available, and this meant heavy overloads during starting and reversing periods.

These several applications require motors ranging from about 5 to 150 horsepower on an intermittent rating basis, with speeds ranging from about 800 to 450 revolutions per minute, respectively.

Whether alternating or direct current should be

The Electric Crane and Hoist in Shipbuilding Plants.

No application of electricity is of such importance or is more extensively used in shipbuilding plants than in connection with cranes and hoists. Heavy material is used almost exclusively and various unique types of cranes have had to be devised to meet the peculiar conditions in these plants. The above views show a number of different types of cranes in use in a prominent shipbuilding shop.



Typical Machine-Shop Operations.

Machine-shop operations as a rule do not call for many special applications. Motor-driven carriers are widely used on large lathes. The accompanying views show a number of interesting motor applications in a large plant devoted to shipbuilding. Motor drive is used exclusively in this as well as in practically all prominent plants.

used on the roll tables, cranes, and other steel-mill auxiliaries is a problem that has been discussed very seriously among steel-mill electrical engineers, and opinions are greatly divided as to which type of motors it is advisable to use. If 220-volt alternating motors are used it is necessary only to use alternating-current transformers to step down the voltage from 6600 to 240 volts, but these transformers have to be large in kilovolt-ampere capacity, as these auxiliary motors run for a great portion of the time underloaded, giving a poor power-factor for the combined load. If 220-volt direct-current motors are used, it is necessary to use motor-generator sets to transform the alternating current into direct current, with a loss of power at this point of about 12 per cent more than in alternating-current transformers, which have an efficiency of about 98 per cent.

Equipment of Typical Mill.

As an illustration of the advantages of electric drive using central-station power the following brief description may be of interest. This mill manufactures sheet steel of commercial and special sizes and galvanizes sheets by a process producing a high-grade coating. The product is used by the trade for making eave-troughs, spouting, roofing, etc.

The main mill has a capacity of from 1500 to 2000 tons per month and is driven by a 34 by 60-inch engine operating non-condensing at 75 revolutions per minute, and nominally rated at 2000 horsepower at 150 pounds boiler pressure. The engine operates the main roll train by the English system of ropedrive, the speed reduction being 2.4 to 1. The main roll train originally consisted of several groups of "hot," "roughing" and cold rolls—the latter being used as the last pass or finishing set to give a surface to the sheets, and are usually located at the extremities of the train and provided with a "drag" or brake to absorb lost motion and chatter in the train, which would otherwise have a marked effect on the finished sheet.

The demand for "high polish" on the finished sheet that would pass rigid examination for absence of wrinkles and chatter marks—and which show more clearly in finished products that are enameled, such as automobile bodies and metal furniture—made it necessary to either use a very heavy "drag," (amounting in some cases to 250 horsepower of dead load) or to roll the sheets during the infrequent intervals that the "hot" and "roughing" mills were inactive. The first method was objectionable on account of the wasteful steady friction load, and the latter curtailed production. Various methods have been tried unsuccessfully, and finally electric driving was suggested and its adoption has been fully justified in every respect as regards power consumption, and especially quality of finished product, which is of the highest grade.

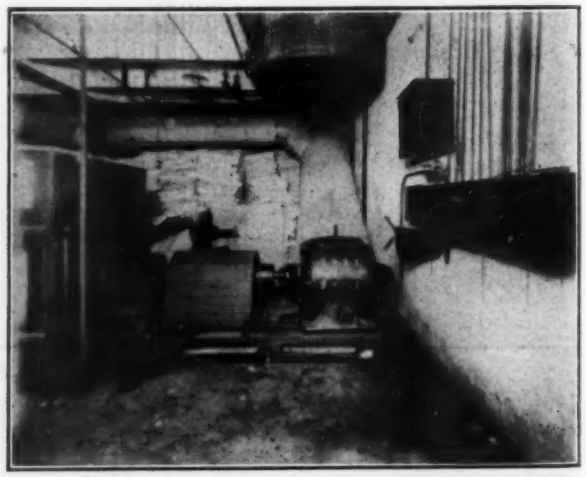
The equipment of the mill consists of three stands of 28-inch in a train driven at 33 revolutions per minute by a 16,000-pound sheave, 16 feet in diameter, which is driven by ten 1.25-inch ropes (English system) from 6000-pound sheave 4 feet in diameter on the motor shaft which operates at 134 revolutions per minute. The motor is of the wound-secondary type, rated at 200 horsepower and operates at 2200 volts. A nine-point drum collector is used.

The extra sheave on the motor shaft will be used for driving a similar mill located in the background. The flywheel is 8 feet in diameter and weighs 14,000 pounds. The flywheel and two sheaves are driven through a coupling next to the motor-shaft bearing.

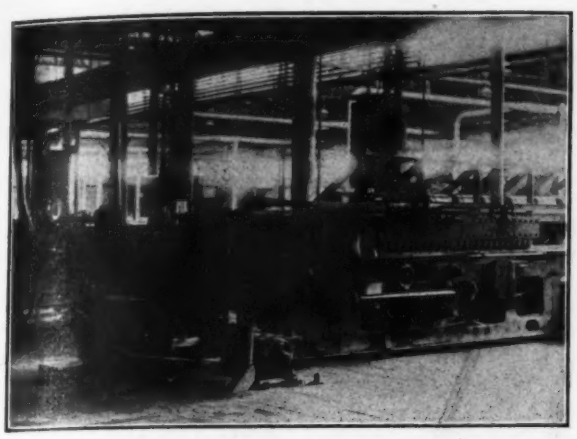
Cold steel sheets are delivered at the rolls which have been set down hard by the large screws through the stands. Each sheet is passed through from one to three times. Generally, two stands are rolling and one stand grinding, the latter operation consisting of clamping large wooden blocks across the top and bottom rolls, the blocks being moved auxiliarly until all surface irregularities are removed. Further polish is then put on the rolls by setting the screw down with a wrench and heavy maul and running with a stream of water flowing over the rolls.

In the "hot" and "roughing" mills a "pack" of from four to eight sheets are put through rolls at once, but in the cold rolls each sheet is passed singly, and the importance of a highly polished surface can be gained from the fact that in handling the sheets must not be allowed to slide on each other, (which would produce scratches) but are turned completely over when removed from the piles to the roll tables. The thickness of the sheets varies from No. 11 to No. 30 gauge; No. 18 to 22 being average gauges. The widths are from 24 to 48 inches and the length 60 to 144 inches.

The equipment was designed for 100 tons in 24 hours, and has been operating from nine to fourteen hours per day. As the sheets require careful and slow handling, and as each sheet takes less than five seconds



Motor-Driven Beaters and Jordans in Paper Mill.



Dovetailer and Planer, Motor-Driven.

to pass the rolls, the flywheel absorbs all peaks due to rolling, the peaks being the result of irregular grinding and are abnormal.

The kilowatt-hour consumption for seven months was:

May	31,900
June	26,700
July	36,700
August	19,800
September	11,400
October	28,600
November	29,500

The contract is on a demand plus an output charge, with discounts for a long term, off peak and primary power. The maximum net bill was $372.00 and the minimum $166.00.

Foundries

MODERN processes for the production of all grades of steel have been brought to such a state of perfection that this metal has to a large extent superseded cast iron in many engineering structures and machines. In the opinion of many engineers this tendency has perhaps been carried too far, with the result that steel and wrought iron are often employed for duties which could be performed by cast iron with equally satisfactory results.

The main problem upon which the iron founder is at present engaged is to obtain a cast iron of a sufficiently high grade as to uniformity, tenacity, hardness and density, to enable it to regain its old position in the eyes of the mechanical engineers for certain classes of work—a position which has been usurped by steel or wrought iron, phosphor bronze and other more costly alloys.

Conservatism, or the tendency to cling to traditional practice, has in the past hampered the iron-founder's art and retarded its progress; but of recent years greater enterprise has been evidenced, and close attention is now being paid to ways and means of perfecting all the details of the craft which go towards improving the nature of the finished product.

In the operation of the cupola one of the most important points to be considered is the source of power that supplies the air to the fuel; and this brings us to the question of the requirements which must be fulfilled by the fan or compressor, or whatever device is employed for furnishing the driving power of the air supply.

The problem of providing a proper supply of air for the operation of a foundry cupola is in many respects similar to the problem of providing a proper supply of air to a blast furnace. The blast furnace requires much larger volumes of air, and under more arduous conditions, since its operation is continuous for many months; whereas the foundry cupola is in operation only through a few hours each day. The latter, therefore, is not subject to the great variations in conditions of operations which occur in blast furnaces due to this long continuous operation, and, moreover, operates under improved conditions owing to the differences between the physical characteristics of the charge of pig iron, as compared with the physical characteristics of the ores which are charged in the blast furnace. Therefore the blast conditions in the cupola are much more uniform than they are in the blast furnace, and the requirements for properly operating a cupola under all conditions can be met by apparatus which produces practically a constant pressure; whereas, in the blast-furnace apparatus, constant volume is the prime requisite, and apparatus must be provided capable of working under a considerable range of pressure in order to meet the fluctuating conditions encountered in the operation of the furnace.

The following table gives the horsepower required for cupola blowers and other foundry machines:

Machine.	Horsepower
Root blower No. ¼	5
Root blower No. ⅛	6
Root blower No. 1, cupola 1.5 tons	7
No. 2, cupola 2.5 tons	10
No. 3, cupola 3.5 tons	15
No. 4, cupola 5.5 tons	25
No. 5, cupola 9 tons	35
No. 6, cupola 13 tons	45
No. 7, cupola 18 tons	60
No. 8, cupola 24 tons	80
No. 9, cupola 35 tons	100
Castling rattlers	2 to 12
Casting grinders	3 to 5

It has been estimated that the foundries of this country melt about six million tons of pig iron and scrap annually, and of this total about one to two million tons is represented by scrap iron and steel. The cost of handling this vast amount of material seems to indicate that the lifting magnet is becoming an economic necessity to foundries.

Results of tests indicate that a foundry melting 35 tons of metal daily can install both a crane and a magnet, and expect a return upon the investment, after allowing all charges, of more than 30 per cent. If it happens that a foundry is already equipped with either an electric or a locomotive crane, a magnet can

then be installed on a very profitable basis when the tonnage to be handled is considerably less. For instance, if an assumption be made that a foundry melts 20 tons daily, and that a magnet be installed on an existing crane, the cost of the magnet being about $900, then the cost of handling, per ton, including wages, fuel, oil and depreciation on the magnet, is about 2.3 cents, which would represent a saving in this foundry of about $924 a year, or more than 100 per cent on the investment.

The lighting of foundries has, perhaps, been given more thought and careful attention than a great many phases of industrial illumination, particularly for the reason that a shop of this kind is one of the hardest to light. At the time of pouring and shaking out, there is always a condition of steam, smoke and dust filling the room, which makes the ordinary forms of illumination practically useless.

While no very high intensity of illumination is required for foundry work, the unfavorable conditions make an exacting demand on the lighting system which has practically limited the types of illuminants suitable for this service to the flaming-arc lamp, the mercury-vapor lamp and the tungsten-filament incandescent. Of course, various local conditions may dictate the use of some other type of illuminant and in fact many foundries are being successfully lighted by means of luminous arcs, but in general the types of lamps mentioned, particularly the flame lamp and the mercury-vapor lamp have been found to meet the conditions in foundries with the best results.

Mercury-vapor lamps are peculiarly fitted for service in foundries and give excellent satisfaction in this service. The great amount of dust and the presence of acid fumes which arise from the operation of pouring necessitates the installation of a lighting unit that has as few moving parts in its mechanism as possible. The mercury-vapor lamp is well known for its simplicity of construction, having only one moving part which is not affected by dust. On account of the construction of this lamp care can be taken to paint the parts inside and out with a non-corrosive paint so that it will withstand any destructive fumes that may occur. Other advantages of the mercury-vapor lamp, aside from its simplicity of construction, are marked economy both in power and maintenance; penetrating qualities of light rays, and the uniform distribution, eliminating shadows in molds.

Number of lamps	Type	Square feet per lamp	Height, feet	Watts per square foot	Maintenance cost per lamp per year
50	HH	1250	32	0.38	$1.87
280	HH	1100	40	0.35	3.18
25	K	1500	30	0.26	2.62
26	K	1500	25	0.26	2.12
28	HH	1200	35	0.32	3.80

The accompanying table gives results of a number of installations of Cooper Hewitt mercury-vapor lamps in foundries, the maintenance costs emphasizing the economy of these units.

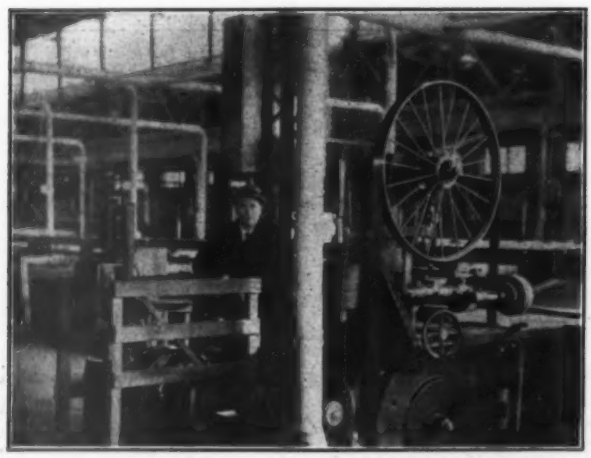
Cotton-Seed Oil Mills

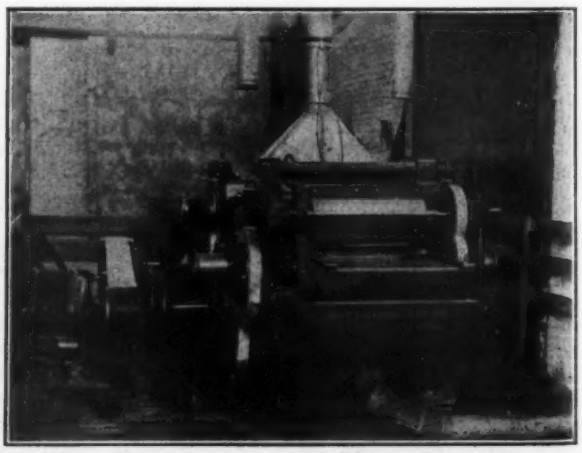
IT HAS only been within the past 30 years that the value of the cotton-seed products has been fully realized, still, in the cotton-growing states this industry is now second in importance, being exceeded in extent only by the cotton mill itself.

The cycle of operations conducted in a cotton-seed oil mill is rather complex being similar, to a limited extent, to flour-mill operation. Cotton seed is first conveyed from the seed-storage house to the various cleaning machines, where the sand, bolls, pieces of wood and other foreign substances are removed. This foreign matter is of two classes, the first, such as sand, is smaller than the seed, while the second, such as bolls and locks of cotton, is larger. Mills of less than 40 tons capacity generally use a combined sand and boll screen, with a revolving reel about 5 feet in diameter and 10 to 12 feet long. The speed of the reel should be 20 revolutions per minute.

From the cleaning processes the seed passes to linters, which are machines for removing the short lint, which is left on the seed by the gins. Linters are all made of one size, rated at 10 tons of seed per 24 hours; but this may be varied from 3 to 15 tons, according to the speed of the feed roll. The slower this runs and the smaller the amount of seed put through, the more lint may be taken from the seed. Most oil mills are so equipped that each linter takes 8 to 10 tons per day. The speed of the saw cylinder should be about 350 revolutions per minute.

From the linters the seed passes to the huller, which is a machine for cutting the seed to pieces, so that the kernel or meat may be separated from the hull. There are two forms of hullers in general use. In one the knives are belted to the driving cylinder, these knives meshing with a set of concave knives along the walls of the seed chamber; in the second type of cylinder





Four-Inch Band Saw and 26-Inch Double Planer Driven by 20 and 35-Horsepower Motors.

Motor-Driven Compressors in Refrigerating Plant.

knives are carried in radial slots in the cylinder, instead of being bolted on. This form of huller is made in only one size, namely, with 30-inch knives. The speed should be 900 revolutions per minute. At this speed the machine has a capacity of 80 tons of seed per 24 hours. The former machine is made with knives 20 inches long or with knives 30 inches long. With 20-inch knives, at a speed of 1300 revolutions per minute the capacity is 30 tons of seed per 24 hours, while with 30-inch knives, operating at a speed of 900 revolutions per minute the capacity is 60 tons per 24 hours.

From the huller, the cut seed is conveyed to a revolving perforated screen similar to the sand and boll screen. The meats pass through the perforations, while the hulls roll out as tailings. This screen rarely makes a perfect separation and as the products leave it there is still some meat in the hulls, and some hulls in the meats. A variety of supplementary machines are in use for further separation, such as shaking screen, revolving beaters in perforated cages, and conveyors with perforated bottoms. The most standard practice is to have a shaker directly under the screen, on which the meats fall as they come through the main screen. This shaker removes most of the remaining hull from the meats. The hulls which come from the main screen are carried to the place of storage or shipment in a conveyor having a perforated bottom, so that the meats yet remaining in the hulls are sifted through and removed by a smaller conveyor underneath. It is usual to equip 40 to 60 feet of the hull conveyor in this manner. The capacity and speeds of separator screens are about the same as sand and boll screens.

From the separating screens, the meats pass to crushing rolls. There are various forms of rolls in use, but they all accomplish the same results in the same way, viz.: by crushing the meats between the successive pairs of rolls. Two methods of drive are in general use, belt and gear. The belt-driven rolls have the advantage of running with less noise, while the geared rolls give less trouble. The capacity of these machines is governed by the number of rolls and by their length. The smallest size has four rolls, 24 inches long, and is suitable for mills up to 30 tons capacity. The largest size has five rolls, 60 inches long, and is suitable for mills of from 80 to 150 tons capacity. The speed of rolls should be 180 revolutions per minute, but this may be varied 15 per cent either way.

From the rolls, the crushed meats are taken to the heater, where they are cooked preparatory to being pressed. The objects of cooking are to coagulate the albumen so that it will remain with the solid matter in the press and not pass off with the oil; to make limpid the oil contained in the meats so it will flow more readily; and to evaporate the excess of moisture. The steam pressure usually carried in cookers is 50 pounds per square inch, but it is universally known that a lower pressure, say 25 pounds, will result in a better grade of oil. This fact is important from the standpoint of the central station desiring to supply energy to an oil mill. During the cooking process the meats are mechanically stirred, this being the only power used in this operation. There are several methods for driving the stirrer shafts. The most popular is to run a shaft underneath the cookers, parallel with them and drive the stirring mechanism of each cooker through bevel gears. Individual drive from overhead belts has also been used. The speed of the stirrers should be about 35 revolutions per minute.

When the meats have been cooked, it is necessary to form them into cakes, which may be put into the hydraulic press. The machine for making these cakes is called a former. A carriage on this machine brings a measured quantity of cooked meats from the heater and deposits them on a press cloth. Steam is admitted under the ram and forces it up thus pressing the cake against the upper frame of the machine. Steam is discharged and the ram drops back into position. The cake is then ready for the press. Formers are sometimes made without the steam-carriage attachment, in which case the operative pulls out by hand the carriage, which delivers the measured quantities of meat from the cooker. Also, many formers are now being designed for compressed-air operation instead of steam. This has the advantage of being cooler and more agreeable to the operatives, and it avoids the unpleasant caking and cooking of the scattered particles of meats which chance to spill out and fall on the cylinders. What is more important, however, from the central-station standpoint is that the use of compressed-air formers, and also presses, decreases the steam requirements of the oil mill to such a point that purchasing energy becomes feasible.

When the cakes have been formed they are lifted on a steam pan and inserted by hand into the compartments or boxes of a hydraulic press, and subjected to the pressure of about 350 tons, for 10 to 20 minutes.

When the cakes leave the presses they weigh 12 to 14 pounds. They are stacked up to air dry for 12 to 24 hours. Sometimes the cakes are put in racks to dry. They are then put by hand into the cake cracker, which grinds them into pieces about the size of a grain of corn, so that they may be fed to a mill for still finer grinding. This machine must be very strong and durable to crack the very hard cakes. The usual form of cracker comprises two corrugated crusher rolls revolving in different directions at a speed of about 300 revolutions per minute.

The cracked cake is taken to the mill for fine grinding. This is usually an attrition mill, of the type used for grinding grain. The attrition mill does its work largely by making the particles of cake grind each other.

All cotton gins are named and rated by their number of saws. The early gins run by horse power had 45 saws. As the mechanical work on the gins became more perfect, and as steam and electric power came to be applied to driving gins, it was found that they could be made to advantage with more saws, so that 60, 70, and 80-saw gins became common. The most popular size gin at the present time is the 70-saw.

Gins are known as right and left hand, according as the driving pulley is on the right or left hand of the machine when standing in front, where the cotton is fed. Most gins have their brushes driven by a belt from the saw shaft, at the opposite end from the main drive. There is another method, however, in which the entire mechanism is driven from the lineshaft underneath.

Only general information can be given on the power requirements of oil mills. The usual allowance of power for various size oil mills is 2.5 horsepower per ton of seed capacity per 24-hour day. The accompanying table shows the average speeds, capacities and power requirements for various machines in a cotton-seed oil mill.

Machine.	Speed.	Capacity in tons of seed in 24 hours.	Horse-power.
Sand and boil screen	20	40	3
Linter	350	5	4
Linter	350	10	3
Huller	900	40	10
Huller	900	100	25
Separating screen	20	40	3
Rolls	180	40	10
Rolls	180	100	30
Heater	105	40	8
Heater	105	100	20

	Speed, R.P.M.	Capacity, tons of product in 12 hours.	Horse-power.
Cake cracker	200	25	5
Cake cracker	300	65	12
Meal mill	1,800	25	25
Meal mill	1,200	65	50
Hull press	100	40	5

In some cases in the table, the machines are given two ratings in capacity and power. In the case of the linters and huller, the variations may be made by varying the amount of material fed; in the case of the other machines, the variations are due to using different size machines for different capacities desired. The capacities and corresponding power required may be widely varied according to the way in which the machinery is forced and according to the general skill in operating the mill as a whole.

Further information on the power required to drive can be obtained from the following data derived from a test conducted at a 24-ton oil mill.

This mill ginned 600 bales of cotton and crushed 3000 tons of seed last year. During that time the total kilowatt-hour consumption was 187,500. The total amount of energy consumed was 10,800 kilowatt-hours; and the energy consumed in crushing 3000 tons of seed was 176,766. Reduced to a unit basis, the energy consumed per bale of cotton ginned was 18 kilowatt-hours and the consumption per ton of seed was 58.9 kilowatt-hours.

The accompanying table gives the equipment of the mill, showing how the present motor installation compares with the actual power requirements of each machine.

	Approximate power required.
Motor No. 1—35 horsepower.	
1 cake mill No. 13½, capacity, 25 tons	40
Motor No. 2—85 horsepower.	
1 set rolls, 24-inch	12
3 Cookers	9
4 Linters, 106 saws each	40
1 Huller, capacity, 60 tons	5
2 Reels and 2 Shakers	5
1 Linter Press	5
1 Cleaning Machine	2
1 Saw Filer	1
1 Sample Pump	0.5
6 Elevators and 300-foot conveyor	10
	89.5
Linter press in only on a few minutes each day.	
Motor No. 3—75 horsepower.	
3 70-Saw Gin	42

As to the application of motors to cotton-seed oil machinery there is much to be learned. As far as is known there has been no deviation made from the main mill drive, although there is apparently no logical reason why grouping the more closely correlated machines would not offer distinctive advantages. The grouping of course depends upon the present layout in a plant. Undoubtedly in some cases no feasible arrangements could be made whereby a main mill drive with its excessive losses and innumerable disadvantages could be replaced.

Grain Elevators

ALTHOUGH operating results indicate that grain elevators can effect a considerable saving in power by purchasing energy from central stations, the advantages of motor drive in this industry are of such importance as to make the cost of power secondary. The field for the sale of power to grain elevators is a large one and worthy of the most serious consideration on the part of the central-station managers. In numerous cases gasoline engine competition is encountered. But even if the cost of energy exceeds the cost of gasoline the many advantages of the motor must convince the most skeptical that the motor drive is ultimately the most economical. It was formerly the practice to drive the legs and conveyors in grain elevators by means of long lines of shafting or by rope or belt transmission operated by reciprocating engines or other engines. Where these conditions exist, especially in elevators of large capacity, having numerous legs and conveyors, it is evident that the friction power to the various sections represented a large percentage of the total power required for operation, and that any reduction in the loss would directly affect the cost of handling the grain.

In the operation of grain elevators where constant speed is required, it will be found that induction motors have advantages that render them superior to any other form of drive. The manner of determining the amount of power required for driving grain elevators with induction motors involves only simple mathematical calculations, with the exception, of course, of determining the amount of power required to drive the various cleaning machines. These, how-

ever, may be readily obtained with the assistance of data giving the necessary power requirements for machines used in up-to-date elevators. The nominal capacity of a grain elevator as usually applied gives no basis for figuring the amount of power required, for the reason that elevators are figured according to their storage capacity; for instance, either 50,000 bushels, 100,000 bushels, 200,000 bushels, 500,000 bushels, etc. The capacity, as applied, means simply the storage capacity and not the amount of grain which can be handled in a given period. In order to determine the amount of power required in a given elevator the operation must be carefully analyzed. It must be ascertained just what amount of cleaning is to be done. Possibly the elevator may be handling a transfer business; i. e., where the grain is transferred from the cars to boats or from one line of railroad to another. Data are available on the operation of several large elevators: the large Trans-Mississippi elevator at Omaha, having a total installation in motors aggregating 427 hp., was found to show the average number of bushels handled per kilowatt-hour during the months of May, June, July, August, September and October was 62.4 bushels of corn per kilowatt-hour; 117.6 bushels of oats per kilowatt-hour; 63.35 bushels of wheat per kilowatt-hour; an average of 81.1 bushels of grain per kilowatt-hour. During September, 104.5 bushels of corn per kilowatt-hour; 195 bushels of oats per kilowatt-hour; 97.6 bushels of wheat per kilowatt-hour; an average of 132.4 bushels of grain per kilowatt-hour. During October 30.66 bushels of corn per kilowatt-hour; 60.39 bushels of oats per kilowatt-hour; 30.27 bushels of wheat per kilowatt-hour; an average of 40.4 bushels of grain per kilowatt-hour.

From the above data it will be seen that it is rather hard to obtain any figures from one elevator which can be used in another elevator. The cost per bushel for handling grain of various kinds is bound to vary. Each case must, therefore, be taken separately and all estimates worked out from data which are available on plants approximately the same size and with about the same conditions of operation. In this way a fairly close estimate may be made.

Brick-Making Plants

IT HAS been within the past 20 years that the introduction of power-driven clay-working machinery has revolutionized the art of brick making and given it its proper rank among the greatest of the world's industries. The present annual production of brick is unknown, but a conservative estimate places the aggregate output of the 100 and more varieties of bricks manufactured in the United States alone, at more than twenty thousand millions per year. This tremendous result has been reached only with the aid of the electric motor.

The machinery required and the methods adopted in the manufacture of bricks are governed largely by the nature of the raw material available and the desired character of the finished product. For the most part, a careful selection from the great variety of standard motors built for general industrial service will fully meet the requirements of clay-working machines. The range of so-called standard motor design is so great, however, that when new installations are contemplated, it is often to the advantage of the customer to take up with the manufacturer the requirements of each proposed application.

In general alternating-current induction motors fully meet the requirements of clay-working machinery. They are of simple construction with large overload capacity and have no wearing parts except the bearings or slip rings, which in every case are of ample design. The particular form of induction motor to use will depend upon the capacity of the distributing system and service characteristics, including such considerations as frequency of starting, starting torque, continuous or intermittent operation, reversal, etc.

For dry pans, sanders, conveyors, fans, bucket elevators and other machines with similar requirements the standard induction motor with short-circuited bar-wound rotor is usually entirely satisfactory. Each of these applications involves continuous duty at constant speed together with relatively easy starting conditions and no occasion for reversal of direction of rotation. On the other hand, for pug mills, augers, tempering wheels, hoists, excavating shovels, etc., where frequent starting and reversal, variable-speed requirements and excessive starting torque are encountered, the induction motor with phase-wound rotor and external secondary resistance is in general recommended. This form of motor with variable

Views in Woodworking Plant Showing Motors Suspended from Ceiling.

secondary resistance is designed to secure maximum torque with the least possible shock to the system when starting under load.

When for any reason direct-current apparatus must be used, motors with compound windings should always be specified, except for driving fans, for which service shunt-wound motors are suitable. Where the service requirements are similar to those outlined for the induction motor with short-circuited bar-wound rotor, the direct-current motor should have the standard amount of series winding; where the induction motor with phase-wound rotor would be suitable for alternating-current service, the direct-current motor should have approximately 40 per cent of series winding and commutator and bearings should be properly protected from grit and flying mud.

If motors are geared or belted direct to any of the large machines without the use of friction clutches they should be designed for a high starting torque since when starting any of these machines full of clay a very large torque is required. Either induction or direct-current motors may be designed to meet these requirements. If friction clutches are used the motors may be started light and the load thrown on later but this introduces another piece of apparatus subject to wear and trouble and should be avoided where possible.

The direct-connected motor drive makes the most compact and efficient layout but care must be taken to see that none of the laws of mechanics are violated; that is, that the foundations are solid, that gears are not run at too high speed, that they are well supported in bearings and rigid, and that the motor is not subjected to severe vibration. Closed motors are not injured by the clay and dust, and if the mechanical application is well made a satisfactory drive is assured.

The following data were obtained from carefully conducted tests on machines in actual operation by a prominent motor manufacturer. It should be distinctly understood, however, that the horsepower required by the several machines mentioned varies widely under different conditions, as will be sufficiently evident from the following figures. Although secured with greatest care for a given set of conditions, in no case should these results be used except for rough estimates of probable requirements.

Standard nine-foot dry pan driven at 170 revolutions per minute by 35-horsepower motor. During test a soft dry shale was fed into the dry pan at an average rate of 9.8 cubic yards per hour. The maximum load recorded was 40 horsepower; the average load 29.6 horsepower. When moderately full of fine dry shale a starting torque of 1450 foot-pounds was required. If clay is wet, as in rainy weather, this value may reach 2000 foot-pounds and the average load may run as high as 50 horsepower. When running empty the dry pan required 12.5 horsepower.

Special double shaft pug mill driven at 135 revolutions per minute by 25-horsepower motor. This machine is essentially a long trough in which the pulverized clay from the dry pan is mixed with water by means of revolving paddles. The load varies with the consistency and quantity of material handled. The effect of the first factor is small but changes of level in the pug mill, due to temporary shut downs of the auger, produce great variations in the power required. With the mill nearly empty, six horsepower is used; with clay up to shaft, 14 horsepower; with mill two-thirds full, 25 horsepower; when even with top of knives, 35 horsepower, and when full, an average of 44 horsepower. When fed at the average rate of 19.5 cubic yards per hour, the average load of the motor was 31.6 horsepower; when empty, five horsepower. The starting torque when the mill is two-thirds full is approximately 2300 foot-pounds.

Ten-foot pug mill driven at 248 revolutions per minute by 25-horsepower motor. The power required with varying amount of material in the mill ranged from 5.2 to 25 horsepower. When fed at the rate of 5.5 cubic yards per hour, the average load was 12.5 horsepower. With mill full the torque required to start was approximately 300 foot-pounds.

Special giant auger driven at 165 revolutions per minute by 125-horsepower motor. This machine is essentially a powerful screw which forces the plastic mass through suitable dies and cuts the issuing clay stream into sections. The load fluctuations are gradual, varying with quantity and consistency of the material from 53 horsepower with the auger nearly empty to 125 horsepower when full. When fed continuously at the rate of 19.5 cubic yards per hour and clay level maintained at the top of the blades, the average load was approximately 100 horsepower. Other test runs show that the power required varies little with changes of speed ranging from 150 to 180 revolutions per minute. The starting torque required varies with the quantity and consistency of the clay and the period of idleness but is somewhat more than 2000 foot-pounds.

No. 1 giant auger driven by 35-horsepower motor. This machine when fed at the rate of 5.5 cubic yards per hour from the pug mill mentioned above has an average load of 18.5 horsepower. The power required varies with the amount of clay in the auger from 12 to 25 horsepower. The maximum possible load with hopper full of hard clay is about 35 horsepower. The starting torque when the mill is filled to level of shaft is 750 foot-pounds.

Eagle repress driven at 100 revolutions per minute. This machine presses 550 bricks per minute, the average load being but 1.8 horsepower.

Belt conveyor. This conveyor consists of a 24-inch belt with 30-foot span running at 150 feet per minute and carrying 19.5 cubic yards of shale per hour. Average load is approximately one horsepower and does not vary appreciably.

Cup elevator driven by five-horsepower motor. This elevator consists of a 10-inch belt moving 470 feet per minute. When raising material to a height of 36 feet at the rate of 19.5 cubic yards per hour, the steady load is 3.6 horsepower.

Drying drum group driven by 40-horsepower motor. This group consists of a belt conveyor which carries the damp clay from a mixer to a drying drum heated by a blast of hot air forced through it by means of two motor-driven fans. A cup elevator carries the dry clay to the bin above. This group is always operated as a unit and requires approximately 40 horsepower when normally loaded.

Dry-press group. This group consists of a belt conveyor which brings the dry clay to the pulverizer where it is ground and emptied into a bin from which it is carried by a cup elevator to the dry press. The conveyor requires about two horsepower when loaded; the pulverizer takes an average load of about 9 horsepower and the cup elevator, 3 horsepower. The dry press running at 130 revolutions per minute and pressing 130 bricks per minute carries an average load of three horsepower, making the total average load when the diversity-factor is taken into consideration about 125 horsepower.

(To be Continued.)

Development of Motor Control

Importance of the Controller in Motor Drive—Use of the Controller for Starting, Speed Regulating, Reversing and Braking—Timely Advantages of Automatic Controllers

To the development of motor control is due no small part of the rapid extension of electric motor drive. Motors are made in a great many types and sizes possessing a wide range of characteristics and it is this fact primarily that makes the motor so adaptable for machine driving of all kinds. However, the requirements of the driven machines as to starting, stopping, reversing and speed adjustment are so much more varied that they cannot in most cases be met exactly by the motor itself without the introduction of an intermediate element that is known as the controller. The function of the controller therefore is to harmonize the characteristics of the motor with those of the machine to be driven. To the ingenuity of controller designing engineers is due the wonderful perfection of this harmonization, which has made it possible for motor drive to meet all requirements of even the most difficult machine driving with better satisfaction than any other kind of drive. In fact it has permitted machines to be operated, in many cases, with such increased output and improved quality of product as was formerly regarded as impossible of attainment.

The earliest controllers in general use were starting boxes to permit direct-current motors to be started gradually without burning out their armatures or blowing the circuit fuses. From this simple device it is an extraordinary advance within 30 years to the automatic control system of a large newspaper press, for instance, with its numerous push-button control stations from which the press can be started, "inched," stopped and locked with perfect safety, or to the control system of a large reversing rolling mill involving momentary loads as high as 16,000-horsepower with speed acceleration to about 120 revolutions per minute, stopping and reversing, accelerating to the same speed, then again stopping and reversing, this entire cycle being repeated approximately three or more times each minute. Less spectacular, but equally important are hundreds of motor control problems whose solution has been worked out with entire success.

Starting Functions of Controllers.

The ideal arrangement on the score of simplicity would be to have the motor connected directly to the line through a simple switch, the closing and opening of which would start and stop the motor. This is possible and is done in the case of only small motors as a rule. The starting current of all the large motors is so heavy under this condition as to cause dangerous overloading to the line as well as serious voltage drop on the circuit, and at the same time likelihood of damaging the motor itself if it must start up under heavy load. To prevent the destructive or disturbing action of heavy starting currents, starting rheostats were developed which limited the current during starting of the motor to a safe and suitable value. This was the first type of controllers and to this day in modified form represents the largest class of motor control devices. Whether under the names starter, starting box or rheostat, or compensator, they serve the primary function of a controller and this suffices where the motor has to operate under practically constant speed.

Starters are of many kinds; they may be divided

Cutler-Hammer Machine-Tool Controller Installed on Grinding Machine. Push-Button Control Station Is Directly Below Oil-Can Shelf.

into two chief classes, rheostatic and reactive. The former places resistance in series with the motor as a whole or in series only with its armature or rotor circuit; this is gradually cut out as the motor speed increases and the counter electromotive force developed by the motor approaches line voltage; at full speed the motor is connected directly across the line. The most common reactive-type starter is usually known as a compensator; it is really an autotransformer which impresses a reduced voltage on the motor during starting; when full speed is approached the compensator is cut out and the motor connected directly across the line.

Most starters have incorporated in their construction a so-called no-voltage release. This automatically throws the contact arm to the "off" position in case of failure of the line voltage, thus preventing the motor from being suddenly restarted by restoring of power on the line without having its starting protection cut out. This is a safety refinement that should be provided on all starters. Many starters also have an overload release, which is merely a circuit-breaker to open the motor circuit and protect it from damage due to excess loads.

Frequently it is desirable to limit the current to safe and suitable values throughout the various stages of starting. This is the case both in non-automatic and automatic starters, especially where the most rapid acceleration practicable is desired. To secure such current limitation involves the addition to the starter of mechanical or magnetic interlocks, current-limit relays, or special automatic contact-making switches known as contactors. While these introduce some complexity in the control equipment, they are extremely valuable in many cases in permitting much more rapid acceleration of the machine than could be possible in any other way, thus increasing the output with perfect safety to all parts of the equipment.

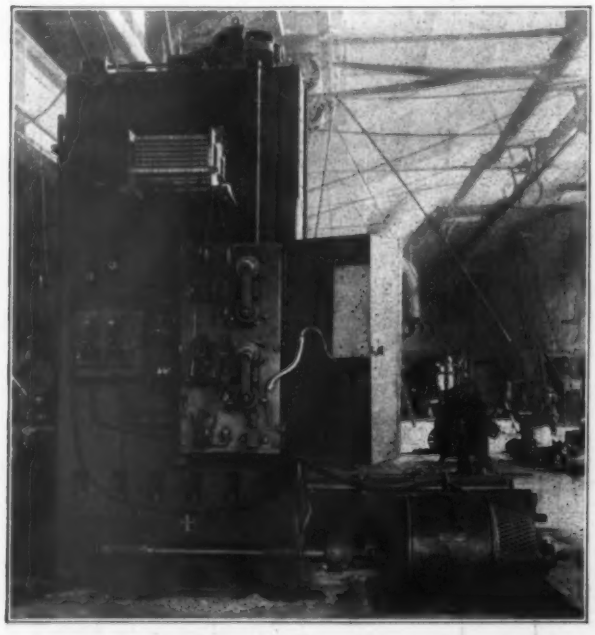
As indicated in the foregoing, starters are in many cases, especially in recent years, of the automatic type. While rather complex in some cases, such starters have been developed to an exceptionally high state of perfection and their prolonged use has shown them to possess marked advantages of which more will be said further on.

Speed Regulation Through Controllers.

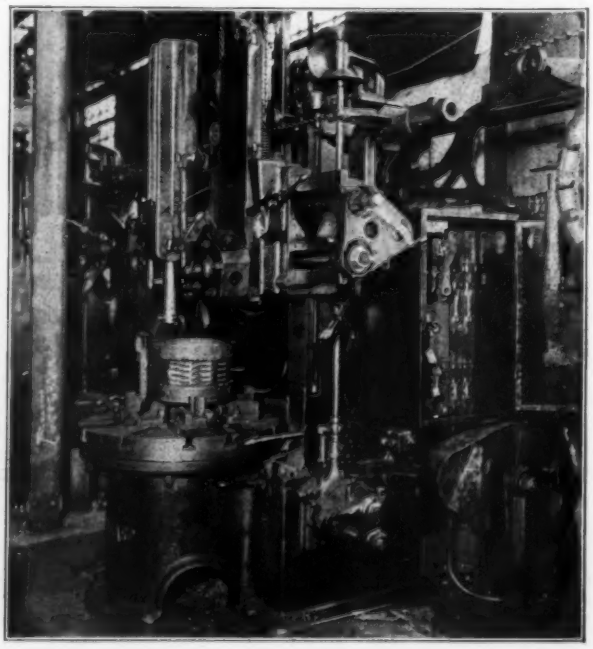
A large percentage of electrically driven machinery must be operated at variable speeds best suited to the particular products being worked upon. In the early days of direct-current motors it was found that a rheostat in the field circuit of a shunt motor gave ready speed adjustment; such a rheostat, of course, was entirely distinct from the starting rheostat and still is in some cases today. However, since speed adjustment and starting were only different functions of motor control and because convenience suggested they be governed from the same point, it was but logical to find them combined in a single controller. This frequently took the form of having separate arms for the starting and field resistances, the two being interlocked until all armature resistance was cut out, when the field-resistance arm was freed for speed adjustment.

In the case of series motors the resistance used for starting was necessarily placed in series with both armature and field and therefore had to be of large current capacity to carry the entire motor current. Since speed adjustment here could be accomplished by the same kind of resistance, the starting and speed-setting resistors were combined in one, and a single controller, usually of the drum type, was used for both purposes.

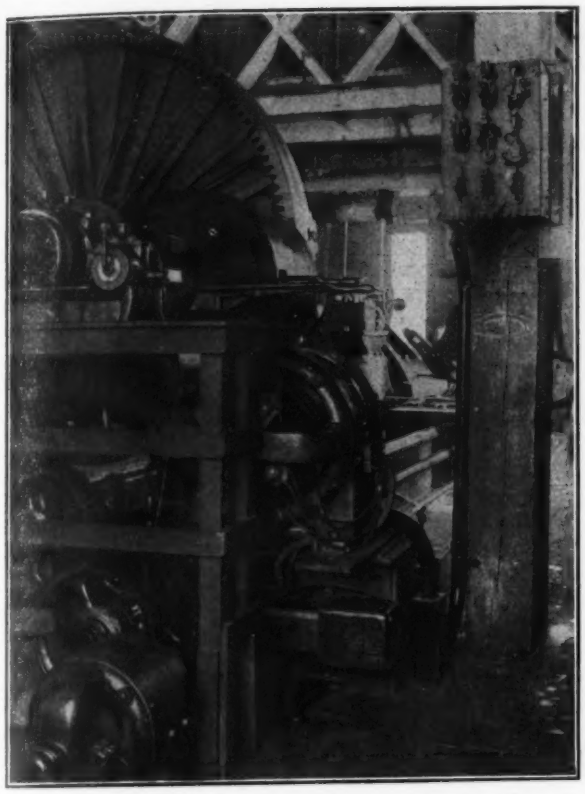
Speed adjustment is not so common in the case of alternating-current motors and is confined almost entirely to the slip-ring type of induction motor with adjustable resistance in the secondary or rotor circuit. This resistance is used both for starting and speed-regulating duties, as a rule, and is of sufficient current-carrying capacity to remain in circuit indefinitely. In the case of very large slip-ring motors to be run at practically constant speed, the secondary resistance is used for starting service only. Starting and stopping of the motor is primarily governed by a switch in the stator circuit, which is usually an oil switch if the voltage is high. The starting and speed-regulating resistance for smaller induction motors may be con-



Westinghouse Automatic Controller on Reversing Planer. Main Controller Cabinet Shown Open.



Westinghouse Automatic Starter Installed on a Boring Machine.



Large Lathe Used for Boring Out Propeller Shafts for Ships. C-H Machine-Tool Controller with Panel on Post.

trolled by a face-plate or dial-type controller, in which case the primary switch and no-voltage and overload releases are usually mounted on the same panel. In larger motors it is customary to use a drum-type controller and in the case of very large motors remote-controlled clapper or magnetic switches or contactors are used to cut out the resistance sections.

Reversing a Motor by Means of Controller.

Certain machines must be operated in both directions at different times, in some cases the reversals being at short intervals. This is especially true of planers, shapers, hoists, cranes, locomotives and other traveling equipment. If direct-current or single-phase commutator motors are used for driving such machines, reversal is obtained by reversing one element of the motor, either the armature or field, or the rotor or stator; if polyphase motors are used, reversal is obtained by reversing one phase of the motor. This reversing of the connections of one motor element or phase is usually done by a reversing switch which may be part of, or independent from, the controller. If reversal is frequently necessary, this switch is for convenience included in the controller; if it is only occasional, the switch is more likely to be separate.

For hoisting or crane service of relatively light duty a face-plate or dial controller has been much used on which the contact arm controlled all three functions of starting, speed regulating and reversing. This was done by having duplicate contact arcs and buttons on either side of the middle or stop position; on moving the arm to one side forward rotation was obtained, on moving it to the other side reverse direction could be had; in either case full speed control was available. The same idea has been applied in the case of some drum controllers, these being used for heavier duty. The ordinary drum-type street-car controller usually has a reversing switch separate from the drum proper, both on account of compactness and because reversal is required normally only at the end of a long run.

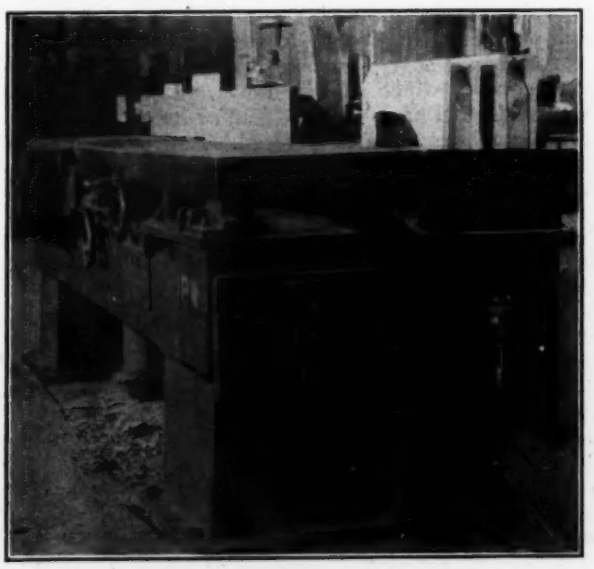
Dynamic Braking Governed by the Controller.

The fourth function for which the controller is sometimes designed for is what is known as dynamic braking. It is employed chiefly on large cranes and hoists, certain locomotives, reversing mill motors and other special machine drives where a very large moving mass must be stopped as rapidly as possible. The principle on which it is based is simple. A motor that is driven by its load becomes a generator and the inertia of the moving load can be quickly dissipated in proportion to the electrical energy thereby generated. By shunting the armature circuit of the motor by means of a low resistance, after shutting off the power but leaving the field energized, the energy is quickly converted into heat and the load brought to a stop. Bringing about the necessary change in the armature connections can be accomplished very satisfactorily by an amplification of the controller, thus centering all four control functions at one point.

Dynamic braking is applicable chiefly to direct-current motors, in which it affords a most effective and efficient method of rapid stopping without using special braking energy from the line. It is the only method of braking that is entirely satisfactory for lowering service on large cranes or similar very heavy loads. On alternating-current motors dynamic braking is occasionally obtained by applying a direct current to part of the phases. More frequently so-called "plugging" is resorted to. This consists in cutting off power and then reversing the motor for short intervals, the reversed torque bringing the motor to rest.

Manual and Automatic Controllers.

The foregoing rough survey of the four principal functions of motor controllers did not touch on some related functions, such as the safety feature which prevents the motor being started until a particular safety button has been released. It was mentioned that several functions are commonly combined in a single controller. This fact, as well as the degree of automatic action provided on the controller, makes it difficult to classify controllers very exactly.



C-H Push-Button Control Used on Buzz Planer.

The earliest controllers were very simple and entirely of the hand-operated type. From time to time automatic features were added, such as the no-voltage and overload release coils, magnetic blowout in the case of large drum controllers, interlocks for multiple-switch starters, etc. Further development was necessitated by the production of very large motors whose heavy currents could not be satisfactorily handled by manually operated contact arms or switches both on account of their unwieldy proportions and the liability to destructive arcing. This brought about the use of solenoid or even motor-operated switches or contactors and led to the perfection of the completely automatic controller.

Semi-automatic and full-automatic controllers are made in a multitude of types, the variety being due chiefly to the special needs of different machines. Leaving out of consideration because of space limitation the control of highly specialized and very large machines, such as rolling-mill drives, locomotives, mine hoists, etc., and referring especially to the more common machine-tool drives, one finds certain general types of automatic controllers predominating. These are plain starting, with or without reverse, for constant-speed machines; starting and speed regulating, with or without reverse and dynamic brake, for use with machines whose speed must be varied more or less frequently. If the speed requires merely to be set and the motor to be accelerated to it automatically, a different type of controller is needed than where the speed is to be controlled at all times from the control point. At the latter some types of master control is provided, either through a push-button station, a small master drum or pilot controller. This master control governs the starting, speed and stopping of the motor, whose actual connections are manipulated by magnetic switches, frequently with auxiliary relays, these switches, relays, circuit-breakers, resistors, etc., being usually mounted on a separate controller panel more or less remote from the master control point or points.

On account of the need for quite a few auxiliaries, automatic control seems at first to be very complex. This is not actually true in most cases. At any rate, automatic control has been developed to such a high state of perfection that it is very reliable. The different parts of the equipment used, contactors, relays, resistors, etc., are all well understood and are now standardized devices and their combination by expert controller engineers and manufacturers produces a highly dependable piece of control apparatus.

Automatic control has numerous advantages over hand control, which it is steadily replacing, although manual control has a distinct field of its own in which it will doubtless remain favored. In spite of higher first cost, automatic control is making constant headway. Among the reasons for this are the following:

It is cheaper and less troublesome to maintain. It furnishes more dependable control, because the control functions (acceleration, for instance) are brought about under conditions predetermined in advance to be the most favorable both for motor and driven machine and are not subject to the whim of a fallible operator. It is much safer to the operator because live contacts are usually remote or at least protected. It enables an unskilled operator to run a machine that he might easily ruin if improperly started or stopped; this is an important point just now when skilled operators are scarce. It permits increase in the output of machines because no time is wasted by too slow acceleration or stopping or improper speed setting; the latter can be set by the foreman or other responsible party; this is another timely advantage at the present. It makes the control convenient and comfortable for the operator and enables him easily by push buttons or a simple master drum to handle a large machine that would require a very powerful man, if manipulation of levers were used in mechanical control, and impose a constant nervous strain where this manipulation was intricate. It permits power economy and avoids accidents to the machinery because it eliminates careless and improper control. It frequently permits a saving in the cost of heavy cables because the actual control panel can be placed near the motor, while the master control point is at some place where the operation of the machine can be best observed.

This brief summary has only touched on a few high spots in motor-control equipment, the development of which to such high standards has facilitated the rapid extension of electric motor drive. The recent marked increase in automatic controllers, the highest development in the controller art, shows that their advantages are being appreciated and this fact is likely to bring about a much more general use of motor drive.

How Electricity Displaces Gas Engines.

Some time ago the commercial department of one of the Byllesby utilities was unable to secure the power business of a prominent concern for a new plant which was being started because of the familiarity of the proprietor with gas engines and their operation. At a cost of $5,000 a gas power plant was installed. Recently the piston rod in one of the gas engines broke, and after working two days and two nights continuously to repair it without success, the proprietor purchased a 75-horsepower electric motor to be shipped by express from New York City for which a bonus of $200 was paid for immediate delivery.

There is a $5,000 gas engine now for sale at Fort Smith, Ark.

Excellent Showing Is Made for First Half Year.—Allis-Chalmers Manufacturing Company sold and shipped to customers products of the gross value of $11,625,290 for the first half of the year 1917, which is at the rate of $23,250,000 per annum, compared with $19,440,509 for the year ended December 31, 1916. The gross sales for the March quarter amounted to $5,183,716; and those of the June quarter were $6,441,574. The net profits accruing for the first half of 1917 amounted to $1,903,127, making an annual dividend, at that rate, of $3,806,254. This would foreshadow a profit sufficient to pay 7 per cent on the company's $15,849,500 preferred stock, and leave a balance of $2,697,000 for its $25,770,750 common stock. The company today has a net quick asset for its preferred of nearly $100 per share.

Half Year Record Shows Great Prosperity.—Westinghouse Electric & Manufacturing Company's business exhibits high figures in prosperity. The first quarter of the fiscal year ended June 30. The gross value of apparatus shipped to customers within that period amounted to $22,288,946. If business is maintained at that rate to the end of the fiscal year, March 31, 1918, the volume will run up to over $89,000,000. This business is that of Westinghouse Electric only, and does not include that of Westinghouse Machine Company, nor the output of New England Westinghouse Company.

New Mansfield Power Station to Supply Steel Mills

Reorganization of Utilities at Mansfield, O., by H. L. Doherty & Company Coincident with Completion of Modern Steam Plant

By HENRY W. YOUNG

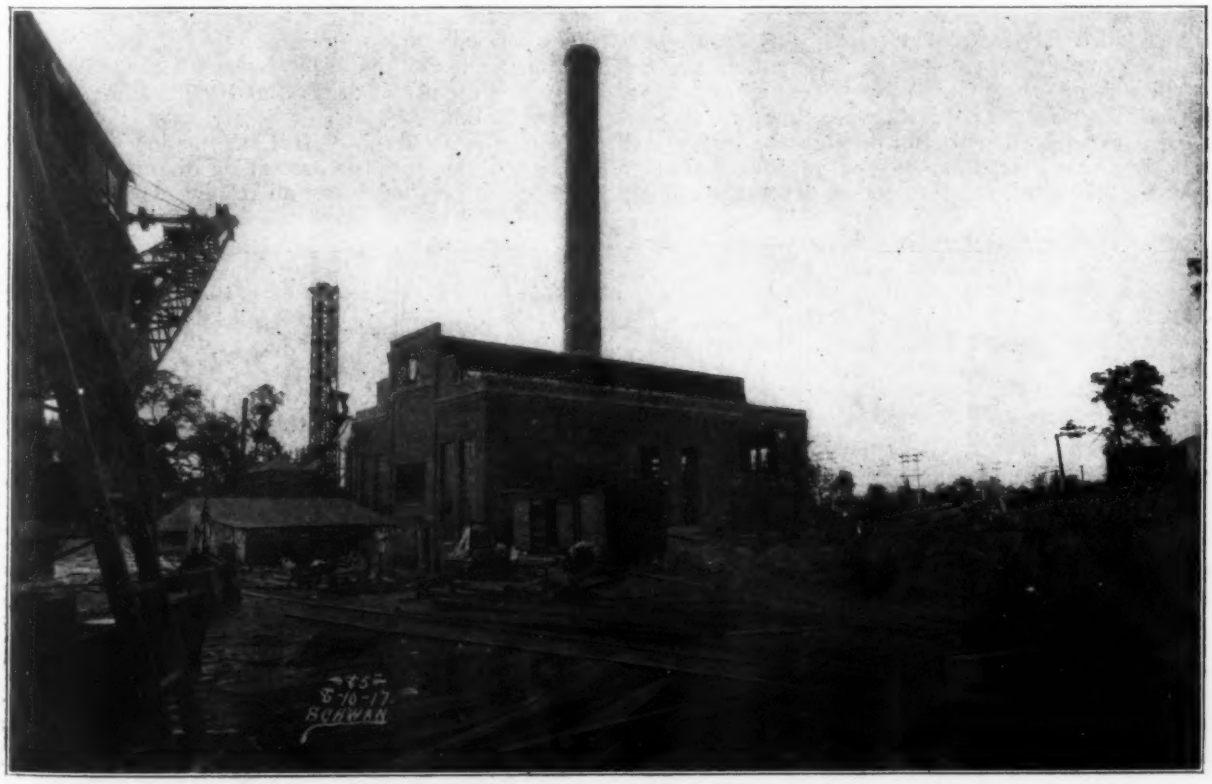
ON AUGUST 7 papers were signed by which the Mansfield (O.) Railway Light & Power Company became the property of the Mansfield Electric Light & Power Company, one of the holdings of Henry L. Doherty & Company of New York. As soon as the final details are completed, transfer of the property will be made. The Mansfield Electric Light & Power Company had been established in Mansfield a few years ago by the Doherty organization, which also controls the gas plant. This last move consolidates the three public service utilities under one management, and will undoubtedly give Mansfield what it has long been sadly in need of—adequate and reliable electric and street-car service. A contract has already been signed with a steel mill in Mansfield calling for an initial installation of 3000 kilowatts, which will later be increased to 6000 kilowatts.

In fact, so futile had been the attempts of the local rail-light company to give anything that could be called service, handicapped as it was for capital, that it has been known that something would have to be done. This was so evident that a new plant was built by Doherty capital and now awaits only a few finishing touches to be ready to step in and begin delivering energy. The substation in Mansfield is practically ready. Paralleling lines in the city have been built and the cutover can be made inside of two days.

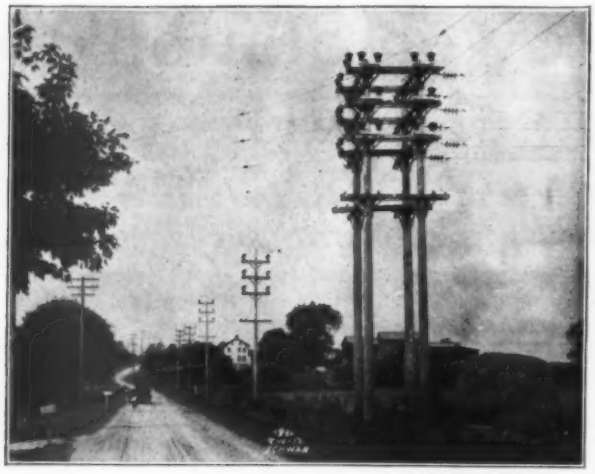
Heretofore, the people did not ride much on the street cars, because the cars did not give service that beat walking. The street cars did not give service because the people did not ride on them and supply the nickels for said service. That was about the situation, and it was about as bad in the case of the light and power service. It was just such a situation as Doherty and his men delight to tackle, and it is reasonable to suppose that in a very short time the people of Mansfield are going to see a marked difference, and the lines of puffing mortals climbing the long hills from the factories in the valley will be diminished.

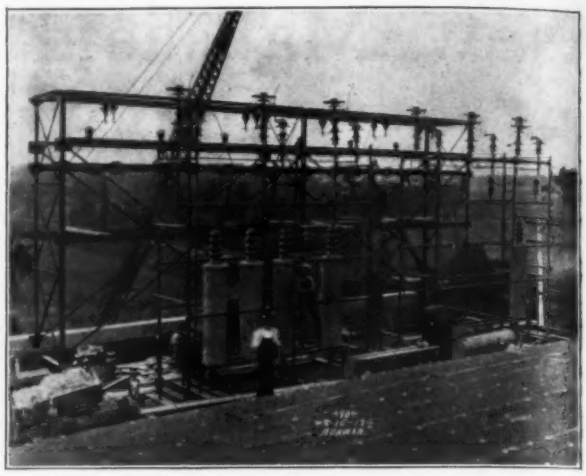
The New Power Plant.

The new plant is located at Melco, O., 11 miles southeast of the city. It was located there because there is plenty of condensing water at this point and also because the company has two gas wells on the property and another one located—sufficient reason to counterbalance transmission losses. Moreover, another city, Ashland, is to be supplied with current—Mansfield, Ashland and the plant forming approximately an equilateral triangle.



View of New Power Station of Mansfield Electric Light & Power Company.





Typical Transmission Line and High-Tension Structure on Roof of Power Station.

At the junction of the Rocky Fork and the Black Fork Rivers, the new plant is rapidly nearing completion. It is a steam plant, with the boilers arranged to be fired by coal or by natural gas as desired. Eventually, 30,000 kilowatts will be developed. The station is designed to take care of generating equipment of that capacity. The present building includes a generator room 62 feet long by 78 feet wide and boiler room 80 by 120 feet. It is built with concrete substructure in which 10,000 barrels of Universal Portland cement was required. This is big enough for the ultimate plant. On part of this is erected the steel-brick building large enough to meet present needs. One of the two stacks is completed, built of brick, by the Heine Chimney Company. It is 200 feet high, 12 feet in diameter. Sterling boilers are installed, Class S-26, rated at 512 horsepower each, with superheater designed to give 100 degrees superheat. They are equipped with Westinghouse No. 7 retort, underfeed stokers for firing coal. The setting is unusual and is of the company's own design. The boilers are elevated and the drums placed seven feet higher than the standard setting. This is because they are also arranged to be fired with gas through the bridge wall from the rear. This gas will be introduced through specially designed gas burners at a pressure of six ounces, although the pressure at the well is 800 pounds and requires two step-downs. There is one large gas well located 4000 feet from the plant. Another is being drilled and the third located not far away.

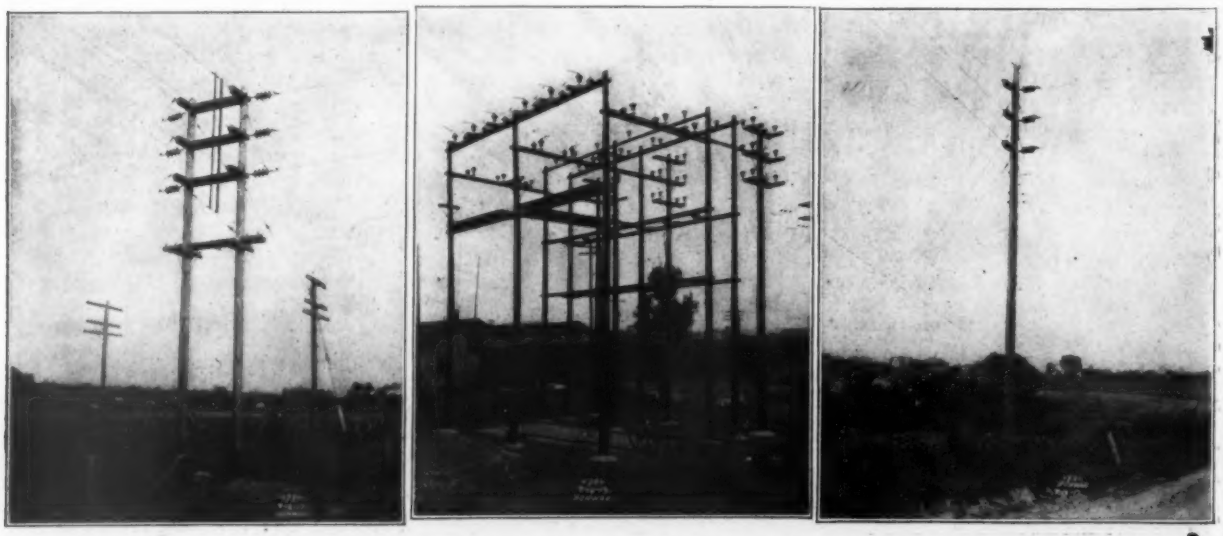
At present there are eight boilers installed. These are expected to be run at a 300 per cent rating.

The pump room is between the boiler room and the generator room and contains five reciprocating feed-water pumps.

In the generator or turbine room there are two 6250-kilovolt-ampere Westinghouse turbo units being installed. They will deliver current at 2300 volts. It was originally intended to install 12,000-kilovolt-ampere units, but it is difficult to obtain such equipment at present and the smaller ones were on order for another property so they were used. The same is true of the two 50-kilowatt exciters. The switching and wiring equipment is all being installed with capacity to serve 100-kilowatt exciters later.

Connected to the totalizing buses are a graphic wattmeter and a graphic voltmeter which will tell at any time the actual demand and the actual variations of the load.

In order to obtain correct information on the operation of the turbines, recording thermometers are placed on the condensers, all reading on one chart as



Three Views of Pole Line Construction Showing High-Tension Crossing, Outdoor Substation and a Right-Angle Turn.

follows: Injection-water temperature; discharge-water temperature; turbine-exhaust temperature.

There is also a Bailey steam-flow meter on the turbine throttle which records steam flow, superheat and steam pressure on one chart, as well as integrating the amount of steam. On each boiler is installed a Bailey steam-flow meter which records steam flow as well as draft pressure, stack temperature and superheat.

A Bailey water meter records the quantity of water in pounds, the temperature entering heater and temperature entering lines.

The piping and pumps are laid out in such a manner that any one boiler or set of boilers can be tested separately from the rest by by-passing the water through meter and feed pumps.

All these things spell flexibility, and it will be a poor engineer who cannot keep the plant at highest operating efficiency with all these checks upon the operation of every part.

Full cognizance is taken of the fact that the plant may be operated with coal as fuel. A big storage bin of 75,000 tons capacity is being built. Coal will go from that, or direct from the cars, to a crusher, and from there by way of a Jeffery conveyor to an 800-ton coal bunker.

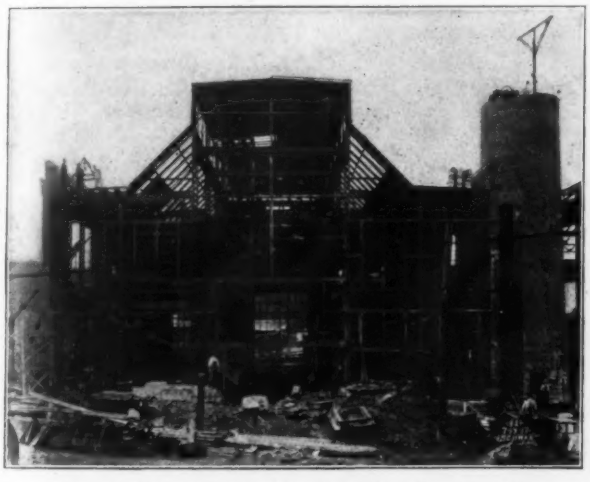
Transmission Lines.

The transmission lines are operated at 44,000 volts. The conductors are No. 0 copper. Insulators of Ohio Brass Manufacture of 50,000-volt size are used. The lines are carried on Idaho cedar poles, 40 feet high, with 8-inch tops. There is a double line of poles over the company's private right-of-way out to the highway, as shown by one of the accompanying illustrations. At the highway the line divides, one going to Mansfield and the other to Ashland. Each carries a ground wire above and another between the high-tension line and the telephone line.

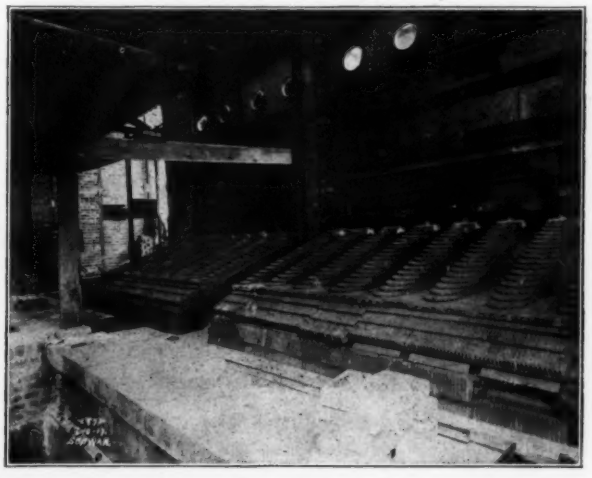
The design of the station was worked out by Victor H. Meuller, designing engineer of Henry L. Doherty & Company. The electrical and sub-station design was directed by H. E. Butcher, designing engineer of the Mansfield Electric Light & Power Company. The work was executed by the Republic Construction Company, in charge of George B. Stanford, chief engineer.

All of the construction work was sublet to the Republic Company, except the installation of the steel superstructure. This is a Doherty company and organized as a matter of convenience and bookkeeping. R. E. Burger is general manager of this company, A. V. Wynne general superintendent, and J. B. S. Coates superintendent. They also hold the same positions with the Mansfield Electric Light & Power Company and upon them will devolve the work of building up the service when it is started.

The construction company at first tried to board and house all its men out at the plant—at some times as high as 200 of them. But they were not commissary experts and wasted a number of thousands of dollars trying to do it. Later they found it much more economical to sublet this part to the Star Commissary Company of Cleveland, of which J. T. Shields is general manager, and saved a great deal of money by this move.



Section Through Boiler House During Construction.



Detail View of Furnace and Stoker Equipment at New Plant.

INSULL INTERESTS BUY WISCONSIN COMPANY.

Controlling Interest in Wisconsin Power, Heat & Light Company Purchased.

Samuel Insull, president of the Commonwealth Edison Company, Chicago, Ill., and his associates have purchased from John I. Beggs the controlling interest in Wisconsin Power, Heat & Light Company, according to reports made public in Milwaukee. The Beggs' interest included public utilities in twenty-seven towns and cities in Wisconsin embracing power plants and transformer systems; also power dams at Kilbourn and Prairie Du Sac, as well as 107 miles of transmission lines in building.

The venture is understood to be a private one on part of Insull and associates. Mr. Insull is chairman of new company which will probably be made a subsidiary to Middle West Utilities Company. Mr. Beggs will remain a director. The negotiations were said to have been practically completed nearly three months ago.

The Prairie Du Sac hydroelectric plant, involved in the sale, is a comparatively new project. A complete description of this plant was published in the Electrical Review of June 9, 1917.

Pennsylvania Electric Convention.

The annual convention of the Pennsylvania Electric Association Section of the N. E. L. A. will be held September 7 and 8 and will be devoted to a discussion of war topics.

FORMS OF ELECTRIC POWER BEST SUITED FOR VARIOUS LOADS IN COAL MINES.*

The Best Form of Power to Be Used in Coal Mines for Drilling, Cutting, Hauling, Pumping, Lighting and Ventilation.

By R. L. Kingsland.

It is intended to deal entirely with the practical applications of electric power to bituminous coal mining. There are two general forms of electric power available; alternating current and direct current. With alternating current we have two standard frequencies; *i. e.*, 25 and 60 cycles, and with both alternating and direct current we have many standard voltages.

In the question of frequency the writer is much in favor of 60 cycles. This has become more and more the standard frequency for central stations. There used to be some advantages of 25 cycles for rotary-converter work, but this has been cut down until today the 60-cycle machine is considered the equal of the 25. This choice of 60 cycles can be further justified by noting that in selecting motors for various mine services to operate between the speed limits of 300 and 3600 revolutions per minute we have the choice of 12 speeds in the case of 60 cycles and only 5 in the case of 25 cycles.

Different voltages are more easily obtained with alternating current than with direct current due to transformers. The rated voltage on alternating-current machines may be misleading from a safety standpoint. This rated voltage is the effective voltage; whereas the peak, or maximum instantaneous voltage, is equal to almost one and one-half times the average value. Thus a person coming in contact with an alternating-current 300-volt line could receive 423 volts, while with a direct-current line he could receive only 300 volts.

The question of transmission is one of the most important in connection with coal mining. If complete copper circuits are used, 3-phase 3-wire alternating current with unity power-factor requires only three-fourths the copper that direct current of the same voltage does. In actual practice, however, in bituminous coal mining work under ground, the nature of the load is such that more copper is required for a 3-phase alternating-current circuit than for a direct-current circuit of the same voltage. This is largely due to the lagging power-factor caused by induction motor load. It is common practice in direct-current transmission underground to use the rail for the return circuit. In the case of 3-phase alternating current the rail may be used in place of one of the wires. In this case the total feeder wire for alternating current unity power-factor and direct current would be exactly the same for the same voltage drop. Actual conditions, however, in this case require even a larger excess of copper for the alternating current than where complete copper circuits are used.

Low Voltage for Underground Service.

What is known as low voltage is steadily increasing in favor for portable machines used under ground. This includes a maximum voltage of 300, with a 10 per cent divergency factor allowed. In other words, the actual maximum voltage at any point on the lines cannot be in excess of 330 volts to come within what is termed low voltage. For stationary machines, medium or even high voltages can be used to advantage, and is safe, if proper protection is afforded.

To summarize, the writer favors the use of direct current or 3-phase 60-cycle alternating-current power at 330 volts or less for all portable machines under ground and considers that stationary machines should be treated individually.

When considering the separate classes of motor-driven machines it is well to keep in mind some of the principal characteristics of the most commonly used motors, *i. e.*, the direct-current shunt and compound motors and the alternating-current squirrel-cage induction motor. For our purposes these are all used as constant-speed motors. In the direct-current motors the speed varies almost directly with the voltage, while with the alternating current the speed is practically independent of the voltage and depends on the frequency. The torque of the direct-current motors varies almost directly with the voltage, but in the alternating-current induction motor the torque varies with the square of the voltage. As an example, if we had one-half rated voltage on a direct-current shunt motor we would have one-half torque, while with one-half voltage on a squirrel-cage induction motor we would only have one-fourth the torque. This is a good point to keep in mind when considering alternating-current motors for portable machines underground.

For underground distribution only two classes of copper conductors have been found practical—bare and lead-covered steel-armored. Other forms of insulation cannot be depended upon for any length of time and are therefore not as safe as no insulation.

In order to cover all classes of load each will be taken up in turn. First we will consider the underground loads and then the surface loads.

Underground Motor Applications.

The machine most used for cutting coal today is that known as the chain machine. The squirrel-cage induction motor is ideal for driving this machine, provided the proper voltage can be supplied to it. Shunt or compound-wound direct-current motors are more frequently used for reasons which will appear later.

Drilling machines used for making the shot holes are made in various types, some of them being driven by the same motors that run the cutting machines and some by separate motors. A constant-speed motor is required and high starting torque is not necessary.

Several types of coal loading machines have been developed, but none of them has come into general use as yet. Motors for these require the same characteristics as for coal cutting machines.

Combination coal cutting and loading machines are being experimented with, but they do not appear to be even as far advanced as the loading machines. Constant-speed high starting torque motors are also required for their operation.

One of the main factors in determining the form of electric power to use underground in large mines is haulage. No practical means has been developed for heavy haulage by the use of alternating current and we are therefore limited to direct current. Haulage may be divided into three classes: trolley locomotive, storage-battery locomotive, and stationary hoist. For trolley locomotives direct-current series motors have proven by far the most practical. For battery locomotives the same is, of course, true. For stationary hoists much depends on the amount of load, the distance from power source by way of the mine workings and

*Abstract of paper read before the thirty-fourth annual convention of the American Institute of Electrical Engineers.

the distance from the surface. More will be said of this later.

Pumps used in mines can be placed in two classes —those used for gathering the water to one or more central points, and those used to remove it from these central points to the surface. For the smaller pumps, or those coming under the first class, it is obvious that the same form of power should be used as is used for cutting, drilling and loading. The larger pumps will be treated with stationary hoists.

Lighting underground can be most easily accomplished by the power that is used for other purposes where the lights are required. That is, it is not worth the extra installation and maintenance expense to string separate lighting lines through a mine. In the case of shaft mines or slope mines it is sometimes advisable to install separate circuits for the lighting where trips of coal are landed, and where the empty trips are made up. Tungsten lamps are the most economical lamp available for the size units required underground. It has been the writer's experience, however, that these lamps do not give satisfactory services on voltages above 125 in sizes smaller than 200 watts. For use on 250 or 300-volt service I have found the carbon-filament lamp to give the best results.

For concentrated loads of 100 horsepower or over such as hoists, pumps and underground substations, I have found separate lead-covered steel-armored cables leading direct from the surface through special bore holes very satisfactory for supplying alternating current at voltages up to 11,000 star. Such cables are practically indestructible. For centrifugal or plunger pump installations constant-speed induction motors of the bore-hole cable voltages can be used with perfect safety as there are no exposed contacts. Hoists can be treated in the same way and where necessary current-limiting devices can be applied so as to cut down the peak load. For underground substations it is generally advisable to transform down to the required voltage in the substation room, in case synchronous converters are used. For motor-generator sets this is, of course, unnecessary.

Advantages of Synchronous Converter.

The question of the relative merits of synchronous converters versus motor-generator sets, while not closely related to the question of selecting the best form of power, is of considerable importance to mine operators. The principal advantages attributed to the motor-generator set are higher power-factor and closer voltage regulation. The advantages of the synchronous converters are lower first cost, small space occupied, and higher efficiency. The writer favors the synchronous converter because he has found that its advantages outweigh those of the motor-generator set in practice. I have operated a central plant having a mine load only, consisting of 25 mines, where synchronous converters were used for supplying all direct-current power, and induction motors for fans, pumps, etc., and where the power-factor was 98 per cent lagging on peak loads, and never went below 90 per cent. I have found that the latest design of synchronous converters will carry momentary overloads of 200 per cent and that motor-generator sets are not good for over 100 per cent overload. The direct-current voltage at the substations was practically constant. When installing a substation inside a mine the smaller space necessary for the synchronous converter will be found to be of great advantage. It is easier to prevent squeezes from above and below with a small room than with a large one.

In locating a pumping station the possible location of a substation adjacent to it should not be lost sight of. This often means materially better voltage conditions for cutting and hauling coal without increased labor cost. The same man can operate the substation and the pump station.

In a great many bituminous coal mines ventilation is of first importance. For this reason we should have the most reliable ventilating equipment. As the squirrel-cage induction motor is the most rugged, as well as the simplest form of electric motor made, it lends itself especially well to this class of work. Through experience I have found that this type of motor gives entire satisfaction. In cases where it is advisable to reduce the volume of air delivered to a mine for certain periods, in order to save power or for some other reason, a two-speed motor of the same type can be used to advantage. Changing the speed of the fan from time to time as mine workings progress can be accomplished by changing the pulley sizes for a belted fan or the sprocket sizes for a chain-driven or geared fan. My own opinion favors belt drives, as these relieve the motor from the cutoff blows of the fan. In case alternating-current power is not available for fan drives, shunt motors should be used, but commutators prevent their giving the same reliable service as the induction motor.

In the preparation of coal one of the principal difficulties that motors encounter is fine dust, and plenty of it. The totally inclosed squirrel cage or, where service requires it, the wound-rotor induction motor meets this condition most successfully. In either case, it is preferable to have a totally inclosed moto.. Totally inclosed compound-wound motors should be used if alternating current is not available where there is a prevalence of dust.

Shop drives and lighting can be classed together because both of these should depend on the primary source of power. They should not depend on the operation of any more machinery than is absolutely necessary. Lights will be required when everything else about a mining plant is closed down and shop operations will also be required when all other equipment is at a standstill.

In conclusion, I would say that for large mines the most practical power for the main supply would be 3-phase 60-cycles at a voltage high enough to reach all necessary points with a loss of not over 10 per cent of the power delivered. This allows the use of alternating-current motors and lights on the surface and also wherever they can be used to advantage underground. Synchronous converters delivering 300 volts direct current can be installed on the surface and underground, as best suits the conditions, and by their use the amount of copper required inside a mine can be kept at a minimum.

If direct-current power is generated it is not economical and often not practical to install several small generating stations. The obtaining of fuel and water often present difficulties. Therefore the direct-current power plant is generally located near the tipple. This means that power can be fed only one way to the mine. With substations located so as to feed power to the load in two directions, only about one-fourth the copper is necessary for the same length of line and the same voltage drop.

For small mines where locomotive haulage cannot be used to advantage, alternating current may be used to advantage for mining machines and pumps. This is especially true if alternating current is available from a central station.

Editorial Comment

Water-Power, Railroads and Electrification—The Government's Part

DURING the war the necessities of both industrial interests and the government are causing a greater degree of co-operation among the railroads than has ever existed before. The results must be permanently beneficial. The effect of such co-operation is, in reality, to truly "nationalize" the whole great transportation system, not by bringing it under public ownership, but in making the railroads a working unit for the efficient service of the country.

The government itself, however, must learn to co-operate with the railroads not only in matters pertaining directly to the movement of freight, but also in affording them proper facilities for operation. One of the principal opportunities in this respect is to be found in opening up the water powers of the country for the use of railroads and industrial enterprises wherever such development is feasible. Among the most interesting and instructive examples of what can be accomplished has been demonstrated in the electrification of certain mountain divisions of the Chicago, Milwaukee & St. Paul Railway on its Puget Sound extension. This has made a remarkable showing in eliminating the use of coal and other supplies connected with steam locomotive operation; in cars released on this account; man power released, not only by reason of the saving in coal and its transportation, but also in the abandonment of water stations and their pumping plants; the difference in maintenance charges between the two types of locomotives, including all fuel, pumping and other plants required exclusively in steam operation; the saving resulting from the handling of longer trains, which reduces the cost for labor, etc., per car-mile, and other very material economies disclosed by experienced investigators. In fact, present conditions along the Montana-Idaho divisions of this railroad and those adjacent to them affected by the same situation prove a strong argument for the early development of water power for similar purposes in all parts of the country.

Another related phase of the same subject is the advantage to be gained from electrification of terminals. Now that the railroads are learning to operate more and more nearly in unison, the serious defects in present terminal facilities for handling rolling stock and traffic are made manifest. The congestion of freight from which the country suffers so greatly results in large part from the inadequate equipment for handling rail traffic in the great mid-West, Appalachian and tidewater centers. J. H. Leonard, editor of "Freight Handling and Terminal Engineering," asserts that steam-operated terminal service is perhaps the costliest feature of general railroad work. When it is realized that the cost of handling a ton of freight at terminals, particularly in the East, is greater than the cost of the haul from Chicago to New York, the conclusion is irresistible that something is basicly wrong.

In urging the railroads to shake off the lethargy which prevents them from modernizing and improving their costly and inefficient freight-handling devices and their disjointed terminal facilities, Mr. Leonard writes: "The railroads of the United States are today handling freight by the same primitive methods that obtained 40 years ago. The result is excessive costs, inefficiency and crudeness in operation. The railroads have made wonderful progress in mechanical equipment, passenger comforts and other facilities, but in the handling of freight, particularly at terminals, they are behind every other civilized country in the world."

Mr. Leonard is probably a little more severe on the railroads than the situation really justifies, but there is enough truth in what he says to make business men urge them to "Stop, Look and Listen," to avoid the government ownership juggernaut.

The chief trouble heretofore has been that each railroad has looked upon the terminal problem from the point of view established by its selfish individual interests. Yet this problem, including economies to be brought about by gradual electrification, can be solved properly in any community only by the co-operation with the community as a whole of all the railroads directly affected. The coming together of the various railroads FOR CO-OPERATIVE SERVICE IN THE INTEREST OF THE NATION at this critical time should prepare the way for radical improvement of the terminals in the freight centers, and also for more intelligent co-operative treatment by the government, by the railroads and by business interests of the general power problem in all its applications.

The great need is for that broad vision which, in contemplating the possibilities of the future, comprehends its every need.

Watch the Boiler Room This Fall

IT is perhaps unnecessary to urge central-station managers to watch their boiler plants this fall with coal at current prices, but a word is not out of place surely regarding the wisdom of planning now to get the utmost service feasible out of the steam end of the station. Only a fortnight or so ago a central station in a well managed group of properties had to

turn down a contract to supply 1500 kilowatts 24 hours a day because of coal shortage, and the importance of getting as efficient plant operation as possible cannot be exaggerated in view of such conditions. An experienced power-plant designer recently remarked that there is far more opportunity to save money in the boiler room than by installing very high capacity steam turbines in plants where smaller sizes will do the work satisfactorily. In the big stations, he intimated, the difference in economy between a 20,000-kilowatt unit and a machine of nearly twice its rating is small in comparison with the opportunity the boiler plant offers to save on production costs. Now is a good time, then, to look into the possibilities of boiler-house instruments, load indicators, steam pressure and flow recorders, feed-water graphs, etc., to go over the piping to make sure that leaks are stopped well in advance of their spreading into heavy money wasters; and to study the scheduling of boiler-plant operation and maintenance, valve arrangements and betterment work all through that vital part of the station between the fire wall and the coal pile. And last, but not least, let the question of liberal boiler-house lighting be taken in hand where necessary and something be done to improve conditions which in many plants are still a disgrace to the electrical reputation of the management.

Spare Motors for Auxiliaries

IN THESE times of motor scarcity, so to speak, it is a good deal of a strain upon a central-station manager to keep spare motor equipment on hand against an interruption in auxiliary service. Prices on extra motors are such that very few indeed go a-begging and the temptation is strong to turn every possible motor unit into ready cash. None the less, a word of caution is not amiss, for when was continuous service more important than today? Whether a plant supplies electricity to mills producing munitions or khaki, tent cloth or automobile tires, intensified production is the order of the day (and night). Hence, it is an excellent plan to make a survey of one's station at this time with the object of learning by the shutdown or partial disability of just what equipment a complete or temporary interruption of output might occur.

Extra motors are certainly not needed for oil-switch banks of the motor-driven type, although one or two reserve units would be convenient in case of trouble. On a pinch, temporary connections can be put through in short order. Again, extra air-washer pumping motors, while desirably installed in duplicate in substantial plants, are not imperatively necessary from the reserve standpoint. Feeder regulators, also, can be cut out of service for the time being without great detriment, whether operated by motor or otherwise. But in the handling of coal, cooling and lubrication-system operation, we see a branch of power-plant service in which reserve motor capacity is an unusually valuable insurance. The characteristics of the fuel-handling system vary, of course, among plants, but in any case where the failure of a motor on a hoist or on a conveyor means that any portion of the plant output is curtailed, provision for immediate substitution of an extra unit is wise. Plants are today running closer and closer to their reserve capacity in many cases; winter is on the way, strange as the thought seems in these days of heat, and it is no time to take chances if a reasonable investment in spare motor equipment can be obtained for points between the fuel-unloading section and the steam-delivery lines where the breakdown of a small but important link in the production chain might prove very costly to the users of central-station service.

Electrical Information for Government Use

HARDLY a day passes that some new problem does not arise in connection with the mobilization of this country for war. As has been often stated, this is a war of engineers, from an industrial as well as from a military standpoint, and in it the electrical engineer is playing a wonderful and most important part.

In the construction of ships, as covered exhaustively in our issue of July 7, electricity is of vital importance and this is only one of the many phases of mobilization which depends in large measure upon electricity. Great distribution systems for electric light and power for the armies in training as well as at the front are necessary and telephone and telegraph communication are as important as the supply of munitions. Electric power in abundance is also needed for cantonments, repair shops, hospitals, etc. How England, France and Canada mobilized for war was discussed at considerable length in our Mobilization Number of May 26.

In this country, through the patriotic organization of individual engineers and engineering societies, the Government has been enabled to draw upon the foremost engineers and scientists to assist in solving its problems and aid in the industrial reorganization of the nation along efficient lines. There are, however, many problems arising that call for special research work or investigation and we in the electrical industry should give unsparingly of our time and resources to aid in this work. A typical case was the need for data regarding electrical conditions in France where X-ray machines were to be shipped. Happily the ELECTRICAL REVIEW could be of assistance in this instance by placing the government engineers in touch with the detailed information.

The opportunities to be of service are many. Every man in the electrical industry, with his specialized knowledge, is an essential factor in the maintaining and development of men, machinery and supplies needed at the front.

HAPPENINGS IN THE INDUSTRY

Move for Greater Co-Operation Among Contractors—New Committees of Engineering Council—Hydroelectric Development on Rocky River—Waterways Commission to Study Water-Power Situation—Miscllaneous News

MOVE FOR GREATER CO-OPERATION AMONG CONTRACTORS.

Membership Campaign Essential Feature of New Propaganda of National Electrical Contractors' Association.

One of the essential features of the new propaganda of the National Electrical Contractors' Association in better organizing the contracting business and increasing the influence of the Association, is a membership campaign intended to interest a large majority of the 25,000 contractors and dealers that are now not affiliated with the organization.

A new constitution is to be proposed at the annual convention in New Orleans, October 10 to 13, and other action taken that will greatly stimulate interest in the industry.

W. L. Goodwin, who is actively engaged in spreading the gospel of greater co-operation among contractors and dealers addresses the following communication to the industry:

The sales possibilities of the electrical industry reach almost inconceivable figures. The present sales approximate $700,000,000. What is the most practical way of doubling this volume in advance of the normal growth and at the same time develop a stable, healthy, profitable situation in all branches of our industry? This is the problem before us.

To undertake this task an organized industry is required. Is our industry organized? In certain branches, yes—for example the central stations and the jobbers have efficient strong organizations while the manufacturers and the contractors and dealers have none. While the manufacturers have even without an organization been fairly successful in solving their problems still their crying need is for proper and efficient distribution.

Lack of proper retail distribution is one of the mill stones about the neck of the industry. We have perhaps 25,000 concerns now engaged in retailing electrical merchandise, but because of improper methods and in fact ills of many descriptions many of these concerns are financially weak. Failures have been innumerable and they will continue with all that it means to all concerned until Mr. Dealer arouses himself from his lethargy and does his part.

The question of retail distribution must be solved or the present most unsatisfactory conditions to all the branches of our industry will continue, and the writer is not at all sure the conditions will not become worse.

The retailers which comprise contractors and dealers need, therefore, a good strong organization comprising national state and local sections. Such an organization can develop a healthy growth in our industry beyond normal growth and all the while producing profit to the interests participating. That is the goal for which the writer is striving. Lining up the industry on the basis of what it means to you should appeal at this time as a movement deserving your hearty support as it is an opportunity which comes to an industry only at rare intervals. And so we suggest that you ask yourself is there any field for an improved condition in the electrical industry?

And my answer is "YES."

So why not all do our part and do it now while opportunity presents? At least join your nearest association of retailers and do your part in this constructive work.

NEW COMMITTEES OF THE ENGINEERING COUNCIL.

War Inventions Committee Among New Ones Appointed to Co-operate with Government.

Subsequent to the organization meeting held on June 27, 1917, the Engineering Council has held two other meetings, one on July 13 and on July 26. It has considered many matters of interest to engineers in general.

There have been appointed the following standing committees:

(1) On Public Affairs, comprising C. W. Baker, G. F. Swain, S. J. Jennings and E. W. Rice, Jr.

(2) On Rules, comprising J. P. Channing, Clemens Herschel, N. A. Carle and D. S. Jacobus.

(3) On Finance, comprising B. B. Thayer, I. E. Moultrop, Calvert Townley and Alex. C. Humphreys.

Many matters coming before the Council, both from the several founder societies and from the Council's predecessor, the Joint Conference Committee of National Engineering Societies, have been considered and referred to appropriate standing committees for investigation and report.

The Council has also created a War Inventions Committee comprising H. W. Buck, A. M. Greene, Jr., and E. B. Kirkby, to co-operate with the Naval Advisory Board and other departments at Washington if desired in the promulgation to engineers of war problems now before the government and for which there are opportunities for solution by means of inventions. It also created a committee comprising George J. Foran, E. B. Sturgis, A. S. McAllister and A. D. Flinn, which is to collect and compile such information regarding engineers of the country as will enable the committee to co-operate with the different departments of the federal government on request and to assist in supplying the government's need for engineering services.

While the Council comprises only members from the four founder societies and of course can claim no right to speak for members of other societies nor for engineers at large, the Council members feel that the body will not have accomplished the results for which it was created unless it early establishes means of cordial co-operation with engineers, organized or otherwise. Every effort toward this end is contemplated.

Activity at Great Lakes and Gulf Shipyards.

Activity at electrically operated shipyards on the Great Lakes is increasing. At the Superior yards of the American Shipbuilding Company four ships are being built for French interests, the first of which, the *Toulouse*, was recently completed and is now on her way to Montreal, enroute to the coast. The *Toulouse* is of Welland Canal size and one of the finest ships intended for ocean service built on the lakes.

At Manitowoc four wooden ships are under construction for Norwegian interests, and the first two are nearing completion. The oil-burning engine for one was recently delivered. A tariff tax of more than $13,000 collected by the government will revert back to the Norwegian interests if the vessel is commandeered for American use.

Two wooden vessels for ocean service are being built in Sturgeon Bay for American interests. Vessels are building at South Chicago for the French and Norwegians. Vessels building in other yards on the Great Lakes are mostly for lake service, and in order to commandeer for trans-Atlantic service would have to be cut in two to be taken through the Welland Canal.

The Kelly-Alkinson Construction Company of Chicago has a contract to construct 18 complete steel and wood ships for the United States Shipping Board Emergency Fleet Corporation for approximately $10,000,000. It has purchased the Hierymymus dock property at the foot of Texas Street in Mobile, Ala.

The company will at once begin the construction of six ways. The company expects to launch the first ship on January 1, 1918, and the entire contract for 18 vessels is to be concluded by November 1, 1918, says a special dispatch from Mobile.

Ships will be 246 feet long, 45 feet 10 inches beam, 2 feet depth, and with cargo-carrying capacity of 3,500 tons dead weight. The contract also calls for complete ships, including machinery and cabin work.

The estimated new pay roll through this industry will mean an additional $100,000 per month. About 1,000 laborers, skilled and unskilled, will be employed, and the population of Mobile is expected to be increased from 3,000 to 4,000 additional by this industry.

W. F. Kelly is president of the company and Mac R. Fife its secretary and treasurer.

HYDROELECTRIC DEVELOPMENT ON HOUSATONIC AND ROCKY RIVERS.

A Connecticut Company Takes Over Four Water-Power Properties—Will Build Steam Plant.

The Connecticut Light & Power Company, which has taken over the business of the Rocky River Power Company, the Housatonic Power Company, the United Electric Light & Water Company, and the Seymour Electric Light Company, is now proceeding with the development of a hydroelectric plant at a site known as Stevenson on the Housatonic River, the total development to be approximately 18,000 kilowatts. The company has also purchased real estate, placed orders for apparatus and material, and is about to start on the construction of an additional steam generating station at tidewater, which, it is expected, will have an ultimate capacity of 100,000 kilowatts, the initial capacity now to be installed being 20,000 kilowatts. The estimated total capacity of the undeveloped water rights acquired by the consolidation on the Housatonic and Rocky Rivers is approximately 75,000 kilowatts, including the Stevenson site, which is now being developed.

The United Gas Improvement Company of Philadelphia is largely interested in the Connecticut Light & Power Company and some of its officials will be actively identified with its management. There will be other interests actively associated with the United Gas Improvement Company in the enterprise. It is expected that the consolidation of the properties will be a great asset to the manufacturing and industrial centers in the territory served.

Association of Railway Telegraph Superintendents Postpones Annual Meeting.

W. L. Connelly, secretary of the Association of Railway Telegraph Superintendents, has mailed a circular letter to the members in which he says.

"With a view of conserving our time and resources to the end of being able to do our part in meeting the present war situation, the executive committee, after due consideration, has decided to indefinitely postponed the annual meeting which was to have been held in Washington, D. C., on September 18. The executive committee has further decided to call a special meeting of the Association in Chicago for a short session of one or two days during the month of November of this year. You will be advised later the exact date. This meeting is to be strictly a business session, free from entertainment.

It is desired that all the committees continue their work as far as possible and be prepared to present reports for discussion and action at the proposed Chicago meeting in November.

"The necessity of postponing our annual meeting is, of course, to be regretted, but under the present conditions it does not seem proper or desirable to carry out our original plans."

WATERWAYS COMMISSION TO STUDY WATER-POWER SITUATION.

Provision of Rivers and Harbors Bill Gives Broad Powers to Proposed New Commission.

By the terms of the new Rivers and Harbors Bill, which has been agreed upon by the Conference Committees, the President is authorized to establish a commission, to be known as the Waterways Commission, consisting of seven members, at least one of whom shall be chosen from the active or retired list of the Engineer Corps of the Army, at least one of whom shall be an expert hydraulic engineer from civil life, and the remaining five of whom may each be selected either from civil life or the public service. The duty of the commission will be to bring into co-ordination and co-operation the engineering, scientific and constructive service, bureaus, boards and commissions of the several governmental departments of the United States and commissions created by Congress that relate to the study, development or control of waterways and water resources and subjects related thereto, or to the development and regulation of interstate and foreign commerce, with a view to uniting such services in investigating, with respect to all watersheds in the United States, questions relating to the development, improvement, regulation and control of navigation as a part of interstate and foreign commerce, including therein the related questions of irrigation, drainage, forestry, arid and swamp land reclamation, clarification of streams, regulation of flow, control of floods, utilization of water power, prevention of soil erosion and waste, storage and conservation of water for agricultural, industrial, municipal and domestic uses, co-operation of railways and waterways, and promotion of terminal and transfer facilities, to secure the necessary data, and to formulate and report to Congress, as early as practicable, a comprehensive plan or plans for the development of waterways and the water resources of the United States for the purposes of navigation and for every useful purpose, and recommendations for the modification or discontinuance of any project herein or heretofore adopted.

PALACE OF AMERICAN ACHIEVEMENTS AND WHAT IT WILL PORTRAY.

Educational Purpose and Scope of Bronx International Exposition.

The Palace of American Achievements will constitute a conspicuous feature of the Bronx International Exposition, which will open May 30, 1918, at East 177th Street subway station and the Bronx River, New York City. The building to be occupied for this purpose will be the largest on the Exposition grounds. In it will be exhibited the earliest models of inventions which have made famous the American scientists.

Exposition representatives are digging up and securing early models of electrical apparatus, automobiles, typewriters, talking machines, aeroplanes, telephones, moving-picture machines, sewing machines, and other inventions representing the triumphs of American genius, for exhibit in this Palace of American Achievements; and the inventions of more recent years will not be omitted.

The Bronx International Exposition is to be a permanent enterprise, conducted along lines similar to those of Shepard's Bush and Earl's Court in London, but the Bronx Exposition will have special features for each year. During the first year, for example, the 300th anniversary of the settlement of the Borough of the Bronx will be commemorated.

The primary purpose of the Exposition is educational, and to this end will be exhibited the latest and greatest triumphs of man's handiwork along artistic, scientific and industrial lines, portraying its progress and development. Fifteen exhibit buildings are now under construction and other buildings for concessions, entertainment and convention purposes are to be built, as well as a swimming pool and bathing pavilion, to be the largest in the world.

NEW ELECTRIFICATION TO BE UNDERTAKEN BY ST. PAUL.

Additional Section of 211 Miles to Make Total of 651 Miles Operated Electrically.

Electrification through the Cascade mountains on the Chicago, Milwaukee & St. Paul Railroad is in full swing and it will be only a short time before the St. Paul's second electrified zone will be in operation. This is the news brought to Chicago by C. A. Goodnow, vice-president of the railway, who has just returned from the West. Mr. Goodnow, who had charge of the first electrification through the Rockies, is directing the new undertaking through the Cascades.

That the St. Paul has under way the electrification of its line through the last of the great mountain ranges hardly a year after completion of its first zone is regarded among railway men as confirming the wisdom of the St. Paul management in this undertaking.

The St. Paul will spend several millions in the Cascades. The electrification from Othello, Wash., to Seattle and Tacoma will add 211 miles to the electric lines, making a total of 651 miles under operation from mountain water-generated power. This gives the St. Paul, in addition to being one of the longest railway systems, the distinction of being the longest electric railway in the United States and probably in the world.

Eight substations will be built in the new zone for delivery of the current to the railway, located at Taunton, Doris, Kittitas, Hyak, the east portal of the Snoqualmie tunnel, Cedar Falls, Black River junction and the Tacoma shops.

Views of Steam-Turbine Stations.

To illustrate an article dealing with the value of electrical securities, which appeared in our last issue, use was made of several views of modern steam-turbine stations, the idea being to show graphically the character of the average central-station plant upon which securities are issued.

Since the publication of these photographs a number of inquiries have been received regarding the locations of the plants illustrated. The views on page 222 showed the Riverside station of the Minneapolis General Electric Company, equipped with Allis-Chalmers units; the Waterside station of the Louisville Gas & Electric Company, equipped with General Electric units; and the Seattle Municipal plant. On page 223 were shown exterior views of the Minneapolis and Louisville plants and an interior view of the Empire District Electric Company's plant, equipped with Westinghouse units and a view of the Rankin plant of the Duquesne Light Company, Pittsburgh, Pa., also equipped with Westinghouse units.

NEWS NOTES

Electric Headlights on Baltimore & Ohio Railroad.—The Baltimore & Ohio Railroad has commenced the installation of electric headlights on all of its locomotives, totaling about 2500. The improvement will be made at the rate of from 75 to 100 engines a month.

Electric Company Abolishes Vacations.—The Harwood Electric Company, Hazleton, Pa., has issued a notice to employees announcing that no vacation will be granted during the present summer owing to the war and the shortage of men through entering the army.

Electric Sign for Trenton, N. J.—The city of Trenton has inaugurated a new electric sign on the Bridge Street bridge across the Delaware River. The sign is 385 feet long and 12 feet high, reading, "Trenton Makes—The World Takes." Electric flags augment the beauty of the sign, with an arrow on one end pointing towards the city proper.

Electrical Convention at Cape May, N. J.—The Automotive Electric Association, composed of electric companies manufacturing appliances for automobiles, opened its annual convention at Cape May, August 8, to remain in session for one week. The meeting is primarily devoted to the parent committee and its work, of which V. S. Beam is chairman.

New Extensions at Fore Yards Ready for Duty.—The Fore River Shipbuilding Corporation, Quincy, Mass., has its new extensions and equipment about ready for use, and these will facilitate the building of 75 ships, orders for which are in hand. There are about 8000 men employed, and the pay roll runs up to $150,000 per week.

Jovians Suspend Dues of Enlisted Members.—The policy of suspending dues of members who enter military service has been adopted by The Jovian Order, according to announcement issued August 3 by Ell C. Bennett, in charge of Jovian central offices, St. Louis, Mo. It is also stated that names of members who have entered the army are desired at the central office of the order.

Banking House Establishes Buenos Aires Branch.—The First National Bank of Boston announces the opening of a branch bank at 501 Bartolome Mitre, Buenos Aires, Argentina. This branch, under the management of Noel F. Tribe, is now doing a general banking business. Inquiries with regard to transacting business between this country and South America are solicited and may be addressed to the home office at Boston or to the branch address: The First National Bank of Boston, Buenos Aires branch, Casilla de Correo 500, Buenos Aires, R. A.

Toronto Interests Oppose Ontario Power Deal.—The Ontario Hydro-Electric Power Commission, Canada, which took over control of the Ontario Power Company plant and business at Niagara Falls, Ont., in exchange for $23,000,000 in bonds of the Commission, is meeting the opposition of Toronto interests. Persons representing those interests have attacked the right assumed by the Province and the Hydro-Electric Commission in taking control of the Niagara River power, and are appealing to the Privy Council of England for a hearing. It is set forth that American water rights in Niagara River will be involved.

Annual Picnic of Electrical Employees.—The Electric Appliance Company, Chicago, its employees and friends, held their fourth annual picnic at Ravinia Park, Ill., on August 15, under the supervision of the Picnic Board. The program, extending from 10 a. m. until late in the afternoon, covered a variety of events, including many races, to the winners of which prizes were awarded, and various contests and games. Luncheon was served from 12:30 to 1:30.

Thomson Quarter Century Club Holds Annual Reunion.—Annually in August the Thomson Quarter Century Club of the General Electric Company at Lynn, Mass., has an outing and reunion. This year the gathering was at Centennial Grove, Essex, and was a great local event. The day was ideal and a large percentage of the 314 members were present. To be counted a member of the club the minimum number of years an employee must have worked is 25, but the maximum is anything above that. Thus, Prof. Elihu Thomson, for whom the club is named, is set down as having been connected with this electrical interest since 1883, together with some 15 others. The club was organized eight years ago, and the members of the committee this year in charge of the outing were: Harry W. Hodgdon, chairman, James R. Viets, Sidney A. Rich and Lewis S. Urquhart, secretary.

A Congress of Safety and Sanitation Is Called.—A Safety and Sanitation Congress has been called to meet in New York City September 10 to 15. Delegates are expected there from many parts of the world. One of the central ideas of the conference is to promote the standardization of safety methods in factories, on railroads and all industries of hazardous occupation. The inception of the congress was in the United States, where thousands of skilled men have been taken by the national draft into the army and navy, and the places of many of them are being filled by inexperienced men. Plans contemplate a Safety and Sanitation Exposition, to occupy three floors of the Grand Central Palace, in which there will be exhibits of safety devices and demonstrations of their uses. Safety of the men in our industries is deemed as essential in war efficiency as well as from a humanitarian standpoint.

Electrical Exports for May Maintain Good Average.

During last May the total value of electrical exports from the United States was well up to the high average maintained during recent months and only slightly below the total for April. As compared with May of a year ago, there was an increase of about $1,150,000, or over 33 per cent. The total for the 11-month period ended May 31 was $46,321,910, compared with $27,103,876 for the similar period in 1915-16, and $17,724,676 in 1914-15.

The detailed figures reported by the Bureau of Foreign and Domestic Commerce for last May and the corresponding month a year ago are as follows:

Batteries	$ 204,526	$ 157,397
Dynamos or generators	235,768	133,531
Fans	66,604	33,528
Insulated wire and cables	627,984	292,083
Interior wiring supplies, etc., including fixtures	121,928	38,393
Lamps—		
Arc	1,643	2,539
Carbon-filament	15,438	9,833
Metal-filament	345,261	140,649
Meters and other measuring instruments	84,294	79,641
Motors	427,224	428,984
Telegraph instruments (including wireless apparatus)	101,940	16,187
Telephones	156,917	358,675
Transformers	151,766	173,988
All other	2,047,418	1,572,175
Total	$4,588,711	$3,437,609

Notes on Commercial Practice

New-Business Methods, Policies, Rates and Kindred Central Station Matters for the Man Engaged in Selling Electricity

TRUMBULL COMPANY BUILDING LARGER PLANT AT WARREN.

Industrial Demands for Power Cause Doherty Company to Increase Annual Output Five-Fold Since 1912.

So many industrial plants have located in the vicinity of Warren, O., in the past few years that the Trumbull Public Service Company has found it necessary to greatly increase its facilities for generating power, and the new unit of the power plant which is nearing completion will increase the generating equipment to 24,000 kilowatts. An idea of how the Trumbull company has grown in five years is shown by the following figures:

Year.	Kw.-Hrs. Generated.	Plant Rating in Kw.
1912	5,593,426	2,700
1913	7,047,174	2,700
1914	7,170,463	4,400
1915	11,842,401	8,400
1916	16,592,121	8,400
1917	27,000,000*	14,650

*Estimated.

The rapid growth of the Trumbull Public Service Company has been attributed to the favorable location of Warren, O. It is on the Mahoning River, midway between Pittsburgh and Cleveland. In the period of five years during which this growth has taken place, the city of Warren itself has made rapid strides. Its population is now about 16,000, which represents a growth of nearly 100 per cent since 1912. More than a hundred manufacturing plants are now situated in that city, the steel and iron works alone giving employment to about 5000 people.

To keep pace with this phenomenal growth has taxed the wits of the Doherty men in charge of the Trumbull plant. With the enlargement of the steel plants and other factories, has come a demand for electric power in small and large blocks that surpassed in volume all initial estimates of expansion.

The system of the Trumbull Public Service Company now extends over a large territory. In addition to supplying the power needed at Warren, it also sends current to Niles, Leavittsburg, Newton Falls, Windham, Garretsville, Phalanx and Hiram—all in the Mahoning River section of Trumbull County, Ohio. The total population of this territory is about 32,000, which means that the Doherty company is furnishing power to a population equivalent to that of a large city. In addition, the Trumbull system operates in conjunction with a steam generating plant at Warren, a small gas-engine plant at the same place, and three hydroelectric power stations on the Mahoning River, two at Newton Falls and the other at Leavittsburg.

Warren being in the midst of an important manufacturing neighborhood, the Trumbull company has made special efforts to obtain contracts for furnishing power to the numerous factories, with the result that at present, virtually every important manufacturing concern in Warren is supplied with power by the Trumbull company. The territory is particularly important in the iron and steel industry, and the Doherty property furnishes electric power to the largest mills in that neighborhood. These include the Trumbull Steel Company, the Western Reserve Steel Company, and the Brier Hill Steel Company. The Liberty Steel Company has announced its intention of establishing a mill at Warren, and the Trumbull company is arranging to supply power to it also. Some of the larger mills take 10,000 horsepower, and the smaller manufacturers range all the way to 500-1500 horsepower in their power requirements.

With this big business to take care of, the Trumbull company has had to provide for additional generating facilities, and the unit which is just being completed is the latest addition to the plant. The new plant extension will consist of a reinforced-concrete structure of the most modern type, and the initial installation of generating equipment will consist of a 6250-kilowatt Curtis type turbogenerator. A 10,000-kilowatt unit will be installed shortly after the smaller turbo-generator is in operation. Nine boilers will be installed in the new addition. The extension has been designed to allow a total generating capacity of 30,000 kilowatts, there being every indication that this amount of available generating power will be needed in a few years.

UNIQUE METHOD FOR APPORTIONING LINE COSTS.

Louisville Gas & Electric Company Adops Plan for Extensions That Encourages Use of Electricity in Outlying Sections.

An interesting and equitable method of apportioning cost of construction of electric transmission lines to supply country homes or other isolated consumers, where the probable business is not sufficient to justify the company erecting the distribution line, has been worked out by the Louisville (Ky.) Gas & Electric Company. This has often been a vexatious problem and one that has not always been solved in a manner which met the ideas of the new customers as to fairness.

An installation of this kind that illustrates the manner of division is just being completed at Louisville. East of the city, along the river front, there are numbers of country homes occupied the year around. Some of the earlier builders installed their own lighting plants, sometimes electric, sometimes acetylene gas. There has never been enough business in this particular section or immediately beyond to justify construction of a distribution line from a Louisville terminal, to which service lines could be connected. So a number of lines such as referred to have been built by the company at the cost of the resident consumers.

This line has six consumers on it, living in a dis-

trict which has been named Glenview. One way to have paid for the cost of this construction would have been to divide the total by six and assess each customer a sixth. Had they all been grouped closely that method might have been approximately fair, but, as the distances ran, the amount of construction necessary to reach the residence of the nearest customer was approximately one-fifth of that necessary to reach the residence of the last house in the line. True, one-fifth is greater than one-sixth, but there was no reason why the nearest customer could not have made an agreement with his nearest neighbor, and by splitting costs on a fifty-fifty basis, really save himself money.

By the plan which has been applied by Robert Montgomery, manager of the commercial department of the Louisville Gas & Electric Company, the customer nearest the station, however, pays only one-sixth of the cost of construction of the line from its point of origin to his home. All six of the beneficiaries from the line share the cost up to the point where the first service line is taken off; all the remaining five share the cost of extending the line from this point to the next home; four share the cost of the extension to the next home; three share the cost to the next service wire splice, while the customer at the extreme end of the line pays for building the last stretch of line to a point where his service wire taps it.

The proposition is this: Customer "A," nearest the station, benefits by the distribution wire only from the point of its origin to the point where his service wire comes off and benefits to no greater extent than do all the others. He gets no return from construction beyond such a point, while the other five have the same benefits as he has. Beyond "A" there are four others who have as much interest in the wire from "A" to "B" as "B" himself has, and so on until the construction for the last consumer, from "D-E" to"F." There "F" is the only interested party.

So, according to the apportionment, all six share equally in cost of construction; the remaining five pay one-fifth each of construction costs from A to B; four split the B to C costs; three the C to D-E costs and F alone assumes the cost of construction from D-E to his station.

Total cost to the Louisville Gas & Electric Company of this line, which is between one and two miles in toto, was $1,963.74. Up to A the cost was $482.76; from A to B, $224.14; from B to C, $362.06; from C to D-E, $785.43; from D-E to F, $109.36.

It works out this way:

A pays $80.46, which is one-sixth of $482.76	$ 80.46
B pays $80.46 plus $44.83, one-fifth of $224.14	125.29
C pays $125.29 plus $90.51, one-fourth of $362.06	215.80
D pays $215.80 plus $261.81, one-third of $785.43	477.61
E pays $215.80 plus $261.81, one-third of $785.43	477.61
F pays $477.61 plus $109.36, D-E to F costs	586.97
Total cost of line paid to company	$1,963.74

The line in question has been constructed and the consumers, though in a district which likely would not be reached for years in ordinary course of distribution line construction, are now enjoying continuous service. There was a feature in connection with this particular line which might be applicable in other instances. This was between the consumers individually and not between them and the company, however, except that the company worked out the division of the costs. Originally this service line supplied only the first three and they paid for construction on the same plan, one-third each to A, B and C sharing half the cost from A to B, and C standing the remainder alone. When the three new consumers came on, by virtue of a gentlemen's agreement, the new customers undertook to assume their prorated costs of the original construction. In making the settlement, Messrs. A, B and C received checks from the other three in the form of rebates on their original outlays by which the investments of the first three were reduced to the figures that have been named above.

Similar extensions of the lines of the Louisville Gas & Electric Company are being made elsewhere in the area it serves and the same principles are applied. Eventually these lines will become generally available to residents of the neighborhoods traversed, as these neighborhoods are occupied, but the pioneer customers of the company are anxious enough to get the service to pay the cost of the construction. This is of a permanent nature and No. 6 wire is used.

Minneapolis Company Again Breaks New Business Records.

An increase of 16 per cent in lighting and power contracts secured, an increase of 22 per cent in total lighting, power and appliance business secured, an increase of 38 per cent in kilowatts of electrical appliances sold by the company and dealers, is the new business record of the Minneapolis General Electric Company for the first six months of 1917 compared with the first six months of 1916.

Already-built houses were wired during the first half of 1917 at the rate of 61 per week. Total electric energy output for the period shows an increase of 40 per cent with an increase of but 35 per cent in the peak load.

Comparative figures are as follows:

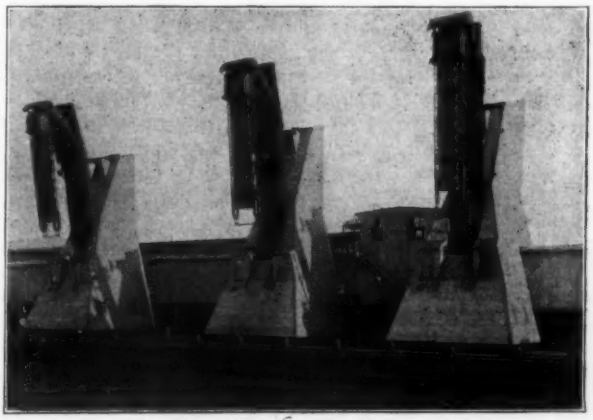
First six months.	1917.	1916.	Pct. Incr.
Light and power contracts secured	9,199	7,907	16
Lighting, power and appliance business secured in K. W.	11,726	9,608	28
Electrical appliance sales in K. W.	3,504	2,539	38
Total energy generated—K. W. H.	101,743,000	73,067,680	40
Peak load—K. W.	42,490	31,480	35

The Minneapolis General Electric Company is one of the principal subsidiaries of Northern States Power Company. The commercial department is in charge of H. E. Young, sales manager.

Unique Electrically Operated Banana Conveyors at Galveston.

The accompanying illustration shows the general construction and method of operation of the electrically driven banana conveyors at Galveston, Texas, as utilized by the United Fruit Company of New Orleans, La.

This method of handling this delicate fruit rapidly and without injury is of special interest. In Texas



Electrically Operated Banana Conveyors at Galveston Dock.

many shiploads of bananas are received to be unloaded and sent by trainloads to western and southwestern cities and the fruit requires careful handling as bananas cannot be conveniently packed.

There are ranged along the fruit wharf a number of pyramidal houses, each with a special type of conveyor. As soon as a ship is laid alongside, the conveyor swings out and drops a long belt down through the hatches into the hold and then the canvas pockets travel in an endless succession from the hold to the wharf.

In the hold the men lay the bunches of bananas onto the conveyor, placing a single bunch in each pocket as it presents itself and as the bunches reach the wharf end they are taken by men to the various railroad cars on nearby tracks.

It is stated that until this mechanical carrier was put to work it was customary to have a long line of men stationed at arm's length apart, extending from the depths of the hold of the vessel to the freight cars on the dock, who carefully passed the bunches of fruit from hand to hand in endless succession, thus necessitating a large number of men and resulting in many handlings.

Electric Trucks Show Marked Economy in San Francisco Delivery Work.

Among the numerous fields of work now employing automotive transportation, the electric vehicle is daily proving itself from many points of view to be the wisest choice for practically every urban use. This is true now, perhaps more than ever before, since war conditions have greatly increased the cost of gasoline, and a great number of those who have not heretofore realized the economy and dependability of the "electric" are now appreciating the advantages which so many have long enjoyed.

That the electric truck is achieving splendid results in the field of delivery work is plainly shown by the following table which gives the operating and maintenance costs of three electric trucks in shipping and delivery work under the abnormally hilly conditions of San Francisco:

	Miles.	Average mileage per day.
1-ton electric delivery wagon, with nickel-iron batteries, in service 46 months	26,528	22.2
2-ton electric delivery wagon, with nickel-iron batteries, in service 39 months	18,910	18.7
3½-ton electric delivery wagon, with nickel-iron batteries, in service 46 months	17,140	14.3

DAILY AVERAGES FOR MONTH OF DECEMBER, 1915.

	1-ton. Month of December. 26 days.	2-ton. Month of December. 26 days.	3¼-ton. Month of December. 26 days.
Mileage	26.84	21.5	15.615
*Cartage	10.273	9.627	12.916
Current (4c per k.w.h.)	.805	.86	.937
Number of marks (packages)	37.08	21.50	20.692
Weight in pounds	4,441.68	8,310.115	14,796.23
Weight per mark (package)	119.786	388.535	715.057

*The item Cartage is the average earned per day by the trucks in dollars and cents and figures on the following drayage rates: Up to 100 lbs., 25c per mark (package); 100 to 300 lbs., 35c; 300 to 500 lbs., 50c; 500 to 1,000 lbs., 75c; 1,000 to 2,000 lbs., $1. Machinery rate, $1.50 per ton.

EXPENSES FOR DECEMBER, 1915.

	1-ton wagon.	2-ton wagon.	3½-ton wagon.
Wages	$ 75.00	$ 91.15	*$104.50
Garaging	20.00	27.50	35.00
Current (4c per k.w.h.)	21.95	22.36	24.36
Repairs and renewals	0.00	0.00	†50.00
Tires	0.00	0.00	0.00
Liability insurance	4.16	4.16	4.16
Fire insurance	2.25	3.37	4.50
Interest on remaining principal	0.00	0.00	0.00
Depreciation (12 per cent)	32.50	40.40	52.40
Total expense for month	$155.86	$188.94	$274.92
Total earnings for month	256.83	250.30	335.84
Net earnings for month	$100.97	$ 61.36	$ 60.92

*Wages include cost of helper when needed.
† Wagon was painted in November.

TOTALS TO JANUARY 1, 1916

	months.	months.	months.
Original total cost of trucks	$ 3,250.00	$ 4,040.00	$ 5,240.00
Wages	3,183.00	*3,184.91	*4,658.12
Garaging	990.00	1,072.50	1,610.00
Current	804.82	764.15	1,076.86
Repairs and renewals	907.14	912.40	1,099.46
Tires	492.91	451.86	552.16
Liability insurance	191.91	162.24	191.91
Fire insurance	103.80	131.43	207.60
Interest	274.58	288.22	244.59
Total expenditures	$10,128.24	$11,007.71	$14,880.70
Total earnings	11,318.33	11,088.47	18,511.92
Surplus above all costs	$ 1,190.09	$ 80.76	$ 3,631.22
Average total cost per month to date	$182.03	$219.06	$261.98
Average total cost per mile	0.382	0.582	0.868

*Wages include cost of helper when needed.

Companies at Denver and Galveston Doing Flood-Light Stunts.

The new-business department of the Denver (Colo.) Gas & Electric Light Company is extending its activities to the selling of flood-lights. At present it is arranging to install such apparatus at the Country Club to illuminate the tennis courts so that they may be used for night playing. In the winter the courts will be flooded and used as a skating rink. The flood-lights will also be used for the rink.

Another novel flood-lighting achievement has been accomplished in Galveston by the Brush Electric Company. That company has installed four flood-lights on the roof of the Crystal Palace to illuminate the dance floor. The idea suggested itself to R. A. Wood, new-business manager of the Brush Electric Company, when he heard that the idea had been worked out successfully in Cleveland. Another thing which Mr. Wood sold to the Crystal Palace is a double-sided flag which is placed at the top of a 90-foot ladder from which high dives are made. Mr. Woods reports that the night effect of this is remarkable, as the ladder cannot be seen and it looks as though the flag were suspended on "sky-hooks."

Fort Smith Company Secures 40 Housewiring Contracts During July.

Up to July 31 the Fort Smith (Ark.) Light & Traction Company reports a gain of 331 electric customers for the year, a considerable number of which are attributable to the wiring of already-built houses. A campaign to secure this class of business has been in effect at Fort Smith for a number of months, and during the month of July, 40 contracts were secured. A plan for reducing electric rates for Fort Smith was announced early in the year, based upon additional customers secured, the first reduction to become effective when 500 new customers had been added to the lines. F. A. C. Tocque, commercial manager of the company, says that at the present rate the 500 will be secured by September 1. Additional reductions will be made when 1,000 are secured and again later when the number has been increased to 1,500.

Electric Range Hatches Chickens.

A. P. Tills, commercial manager of the Northern Idaho & Montana Power Company, Kalispell, Mont., advises that new uses for electric ranges are found every day. Here is the latest, the quotation being from a local newspaper:

"Mrs. Frank J. Kerns used her automatic electric range to hatch chickens last week. Old mother hen refused to set longer on the eggs on account of the extreme hot weather. Mrs. Kerns immediately transferred the eggs from the nest to the oven on her electric range and to her surprise the next morning she had 14 little chicks. All are alive and doing well."

Electrical Construction Notes

A Department Devoted to Problems Relating to the Installation, Operation and Maintenance of Electrical Equipment

POOR CONSTRUCTION OR CARELESS OPERATION AND MAINTENANCE THE ONLY CAUSE FOR ELECTRICAL FIRES.

Reports of Several Fires That Emphasize the Need for Good Construction and Proper Maintenance.

In the early days of the application of electricity, before the laws for its safe and effective use were generally known, a large number of fires were caused by poor insulation, poor connections, overloading of unprotected circuits and other similar difficulties that were usually included under the common excuse of "crossed wires." As the rules for electrical installation became more and more strict and as they were more generally enforced by electrical inspectors the number of fires due to true electrical causes has steadily diminished until now one hears but seldom of fires attributed to "crossed wires."

However, electrical fires do still occasionally occur, sometimes in buildings wired in the early days before inspection amounted to much of anything, sometimes in places recently wired where additional circuits or extensions have surreptitiously been put in, and sometimes in places that were well wired at the time of installation, but where careless or grossly negligent maintenance has allowed the system to become hazardous.

Insurance interests are all the time studying the causes of fires and how these may be eliminated. In this effort reports of fires are made and carefully analyzed. Reports of some 30 cases of recent electrical fires are given in the July issue of *Electrical Data* published by Underwriters' Laboratories, Incorporated, Chicago. From this collection the following typical cases are taken and brought to the attention of our readers in the hope that this wider general publicity will stimulate the movement for better electrical construction and greatly improved maintenance of electric circuits. A study of these cases will disclose the fact that all these fires were not only avoidable, but were due primarily to poor construction or careless operation and maintenance, for none of which there is nowadays any excuse.

Fire in a Garage from a Worn Portable Cord.—The cause of this fire was due to a short circuit in a reinforced cord used for portable purposes. This cord was attached to the ceiling of a garage and repair shop and had become worn by coming in contact with automobile tops as the machines were driven into the garage. It was at this worn point that a short circuit occurred. The burning insulation fell to the floor of the shop which was soaked with gasoline. Loss, $4,000.

Fire Escape Carries Street-Railway Current into Building.—The manner in which a fire escape assisted in conveying electric current into a building and started a fire is told in this account. The property consisted of a group of buildings, some of which were used as stores, some for light manufacturing, the principal occupancy being a hotel. On the front of the hotel is a fire escape which acted as an electric conductor. Among the wires at the front of the building are some street-railway feeders. These feeders were erected before the fire escape was placed on the building and with the putting in place of the escape the feeders were incased in wooden sleeves where too close to the iron work. During a noon hour one of these 250,000-circular-mil feeders, unprotected because of damage to the wooden sleeve, came in contact with a handrail support on the escape and an arc was formed which lasted until the cable fused and fell apart. The fire escape extends from the first to the fifth floors with a platform at each floor. Its supports are secured in the stone wall, except at the top, where the rods extend through a wooden cornice; the wall and then into wooden sheathing where the rod is held by an iron plate and nut. These were in contact with an unused gas pipe, and this in turn was in contact with the roof drain. The current from the feeder passing to the fire escape, traveled up the iron work to the fifth floor, melting the metal at several points where the contact was poor. At the fifth floor the current passed into the building over the supporting rod, and thence to the nut, plate, gas pipe and sewer piping. The supporting rod was fused on the outside of the building. The heat caused by the current through the resistance of the leaded joints of the sewer pipes ignited adjacent wood sheathing. Small fires were started in different parts of the fifth floor where sewer or water pipes were located, the leaded joints of cast-iron sewer pipes being melted. In several places where water pipes were in contact with sewer pipes, arcs were formed which melted both. A passer-by saw the arc at the fire escape and pulled a public fire-alarm box. All of the fire damage was confined to the fifth floor and a sprinkler operating held the fire in check at that point, but two streams had to be used intermittently to extinguish the blaze which extended to the blind roof space and to the outside cornice. Chemical extinguishers were also used to extinguish small outbreaks at various points in the building.

Wires Grounded in Pull-Box.—Investigation of the origin of this fire showed it to be due to a grounded conductor in a metal pull-box situated on the ceiling of the filling and sewing room of a blanket factory, the resulting arc burning a hole in the metal cabinet, distributing sparks and molten metal over highly flammable material in the vicinity. The wiring is in conduit throughout. Near the point of entrance of the service wires supplying the building is a metal pull-box containing joints and taps on three No. 000 rubber-insulated wires which carry the main current for the building. The circuit was fused on the main distributing panel located in an adjoining building but due to frequent "blowing" of the fuses under operating conditions, these had been reinforced by copper wire so that they were inoperative under normal conditions of overload and high-resistance grounds. Investiga-

tion after the fire showed that this condition prevailed more or less generally on the motor circuits throughout the plant, copper wire and stove bolts and similar contrivances being utilized to build up the capacity of fuses, and in some cases the wax finish on rubber-insulated conductors showed evidence of serious overheating. At the time of the fire, an electrician engaged by the company to install an additional motor circuit was investigating the possibilities of further tap circuits from the No. 000 service wires, and in forcibly closing the cover to the pull-box the stranded wire of one of the soldered joints in the box punctured the insulation and grounded on the metal cover. Because of reinforcement of fuses, serious arcing continued until the short circuit burned itself clear, incidentally melting a hole in the metal door, distributing sparks and molten metal over the piles of cotton down on tables in the vicinity. This material took fire readily, the fire spreading rapidly until extinguished by the automatic sprinkler system with which the building was equipped. The loss, confined to contents of filling and sewing room, was estimated at $200.

Defective Insulation in a Fixture.—A short circuit due to defective insulation in a combination fixture created an arc of sufficient intensity to puncture the gas pipe below the joint and ignite the gas. Loss $50.

Fuses Bridged with Pennies.—A short circuit occurred in a flexible-cord pendant destroying the cord and burning itself out at the ceiling rosette. An investigation developed the fact that the socket was not bushed, the cord was not knotted in socket cap and blown fuses on the circuit were bridged with pennies. The damage was confined to the socket, cord and rosette. The ceiling, which was unpapered, was only slightly smoked.

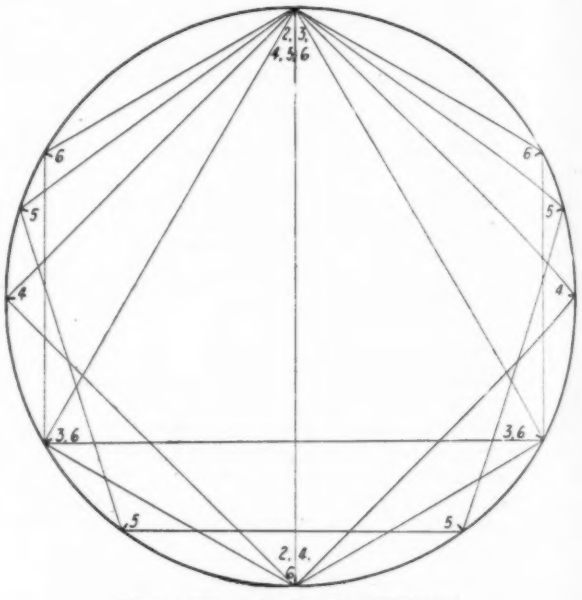
Metal Staples Used for Lamp-Cord Support.—In a three-story brick building the occupant of the first floor, desiring an additional light, connected a lamp cord to one of the fixtures and then ran the cord along the baseboard to the point where the light was desired. At intervals the cord was supported on the baseboard by metal staples. One of these short-circuited the cord and the resulting fire caused a loss of $60.

Fire from Concealed Knob-and-Tube Work.—One side of the circuit in a concealed knob-and-tube job was not properly insulated from a concealed iron beam. The insulation on the wire broke down, an arc was formed and a fire followed which resulted in damage to the amount of $1000.

Live Wire to Pilot Light Ignites Gasoline.—A gasoline pump in front of a building was being removed to make way for a new pump. The pilot or advertising light inclosed in lettered globes on the pump were controlled by a single-pole switch within the office. Instead of removing the fuses from the cutout, the single-pole switch was thrown open. This switch was in series with the neutral wire so that current was thus still on one wire to the lights. In taking down the pump this live wire was broken and grounded on the pump. A flash ignited the gasoline, ten gallons of which were burned up. Prompt action by employees extinguished the fire.

Metal Film Box Short-Circuits Wires in Booth.—A metal film box containing 2000 feet of motion-picture film came in contact with the live terminals of the rheostat of a projecting machine. The short circuit melted two holes in the box and ignited the film. The fire was communicated to two other films, each 1000 feet in length. The damage was confined to the films and to the scorching and burning of paint.

Gauge for Laying Out Fixtures.—Much time is lost in fixture shops that are operated by inexperienced electricians, due to the absence of a satisfactory gauge for marking fixtures. I have found a very convenient one to be made of a sheet of tin 10 inches in diameter. On this a circle is carefully drawn and cut exactly to the circumference. On the circumference are marked the points for 2, 3, 4, 5, 6, or even 8 arms, if necessary. These points are located by means of a divider or compass, and after being located are scratched into the metal with a short but distinct radial mark. With the use of this gauge or template it is very easy to mark off holes in a ceiling band or fixture pan. If the gauge is to be used on a pan larger than 10 inches, this can be done by placing the gauge in the exact center and placing a ruler so that it extends from the center of the gauge over the mark and to the point where the



Simple Gauge for Marking Fixtures.

hole is to be drilled. This kind of gauge is in use as shown or in modified form in most fixture shops, but many electricians attempting to lay out the fixtures waste much time because they are unfamiliar with it.

R. A. JEFFERS.

Among the Contractors.

The Wyoming Electric Company, Philadelphia, Pa., has received a contract for electrical work in the new school to be erected by the School Board of Upper Darby Township.

Walter J. Coleman, 29 Willow Court, Jersey City, N. J., has received a contract for electrical work in the new public school to be erected by the Board of Education, Hoboken, at Adams and Fifth Streets, at a price of $14,975.

The Electrical Contractors' Association of New Jersey has been reorganized under the name of the Electrical Contractors' and Dealers' Association of New Jersey. The new organization will admit electrical contractors, dealers, jobbers, architects, central-station men and manufacturers. The association now has about 200 members. Charles R. Newman, Passaic, is president.

National Association of Electrical Inspectors

WASHINGTON DEVEREUX, President, 131 South Fourth Street, Philadelphia, Pa.
JOHN KELLY, JR., Vice-President, Camden, N. J.
WILLIAM LINCOLN SMITH, Secretary and Treasurer, Concord, Mass.

R. P. STRONG, Representative on Electrical Committee of National Fire Protection Association, 809 Hibernian Bank Building, New Orleans, La.

Executive Committee
J. C. FORSYTH, Chairman, 123 William Street, New York City.

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"LET THE CODE DECIDE."

The matter appearing in this section consists of questions on the National Electrical Code, its interpretation and meaning, and questions as to whether certain methods of wiring are in accord therewith. These questions are gladly received from anyone interested, even if not a member; they should be sent to the secretary with any needed elucidating sketch. They are answered by each member of the Executive Committee, according to his knowledge of what the ruling would be in his jurisdiction.

It should be understood that no pretense is made to give an authoritative interpretation of the Code. This is a voluntary association; it has representation on the Electrical Committee of the National Fire Protection Association, which prepares the Code, but it has no right, and claims no right, to give a final interpretation of anything in the Code. It is only intended to give the interpretation which seems correct to the members of the Executive Committee. No attempt is made to edit or correlate the answers from the different members of the Committee, as it is felt that the occasional difference of opinion is calculated to lead to a further study of the matter in question, further discussion and the final clearing up of obscure points.

The aim is to help toward a better understanding of the Code on the part of all; a more uniform conception of its meaning; increased precision in applying it; and harmonious action of those using it, for the common good.

CONCEALING THE GROUND WIRE IN A BUILDING.

Question 347.—At one time the Code had a positive statement against concealing the ground wire in a building. This point is not so clear in the present edition. In the case of a service entering an upper floor of a building, would it be permissible to conceal the ground wire in the partition to the basement?

Answer 1 (*O*)—The Code of dates prior to 1907 required the ground wire to be outside the buildings. Now this is only required "where practicable"; therefore, the placing of the ground wire in the partition or building wall would in most cases be a violation of the Code requirements.

Answer 2 (*T*)—I am not positive as to the interpretation of the Code on this question but from Rule 15*g* it would seem that it would be proper to conceal the ground wire provided it had an insulating cover of rubber and were installed according to Class C rules of the Code.

Answer 3 (*R*)—This is evidently a secondary ground wire. If such be assumed, it or its inclosing conduit should be run exposed.

Answer 4 (*P*)—The Code does not prohibit the concealing of a ground wire in a partition, provided, however, the wire is run as if it were a circuit wire.

Answer 5 (*F* and *G*)—We permit the concealing of a ground wire in a building when installed in accordance with Class C rules, but require the ground *connections* to be exposed to view or accessible.

Answer 6 (*A*)—I do not know that the Code has changed its statements about concealing the ground wire. It should be run on the outside, entering the basement through porcelain and run on knobs to where it is attached to water pipe.

Answer 7 (*H*)—In the specific case mentioned it would seem to be a dangerous construction to run a ground wire concealed in partitions. A better construction would be to use wood molding, if the use of the rooms through which the ground wire runs renders it inadvisable to use unprotected wire.

Answer 8 (*C*)—The ground wire should be kept on the outside of buildings and attached to ground rod. A tap may then be taken from the outside and brought into the building for attachment to water pipe, if near and immediately inside of foundation.

Answer 9 (*M*)—Yes. It would be permissible, provided the construction renders an outside run inadvisable and provided the connection to the ground or water pipe were exposed to view or accessible.

Answer 10 (*E*)—I do not understand that the ground wire can be concealed in a building because of the requirement that it be run outside if practicable.

Answer 11 (*K*)—Connections to grounded conduit and ground must be exposed to view, but the wire may be concealed.

Answer 12 (*N*)—The Code contains no distinct provision against concealing the ground wire. The requirements are:

(a) Must be run outside so far as practicable.

(b) Where run through any part of a building, unless in approved conduit, it shall be protected by porcelain bushings through walls or partitions and shall be run in approved molding, except that in basements it may be supported on porcelain.

Nothing is said about exposing the molding, but the requirement seems to be clear *it must be in molding* unless in conduit.

WIRING OF THREE-WAY SWITCHES.

Question 348.—Rule 24*c*, third paragraph, states "three-way switches are considerad as single-pole switches." Does this mean that only one pole or leg of a circuit shall be broken by the switch? Does it mean that both live wires of a circuit shall not enter the switch?

Answer 1 (*O*)—Through the 1909 edition the Code required that only one pole of the circuit enter a three-way switch. This requirement was then dropped in 1911 with the distinct understanding that the rule quoted should not be interpreted to prevent both poles from entering the switch.

Answer 2 (*T*)—My interpretation would be that such switches should be used only on one leg of the circuit and on circuits of not over 660 watts capacity.

Answer 3 (*R*)—Personally, I think the Code intends either method of connection may be made.

Answer 4 (*P*)—This paragraph is in effect merely a warning that three-way switches do not effect a double break in the circuit and, therefore, must be considered as single-pole switches.

Answer 5 (*F* and *G*)—Our interpretation of this rule is that three-way switches are to be considered single-pole, in order to emphasize the fact clearly that in no case can they be considered as double-pole, even when both wires enter the same switch or for any other reason.

Answer 6 (*A*)—Usually only one live wire enters each switch. At one time it was customary to connect the live wires to the wires between the switches. Judging from those I have seen, it is unsatisfactory.

Answer 7 (*H*)—It would seem from the use to which a three-way switch is put the single leg of the circuit is in use, but both live wires of the circuit must enter the switch structure (not necessarily the contact points) to make it of any use.

Answer 8 (*C*)—The rule does not require that the two live wires must not be brought into the switch. In either case the switch is still single-pole. We always have ruled against bringing the two live wires into this type of switch, however.

Answer 9 (*M*)—In view of the very definite statement that these switches are considered single-pole, I should say that only wires of the same polarity could be brought into the switch.

Answer 10 (*K*)—Must be wired as single-pole switches.

Answer 11 (*N*)—This rule originally read as at present with the additional phrase "and only wire of one polarity must enter the switch," or words to that effect. This was stricken out in 1911.

At that meeting I personally asked the question, "Is this modification to be interpreted to allow of the plan of wiring in which both line wires feed both switches, the lamp tieing between the two third points?" The reply was, "Yes, exactly for that reason." I find this in my copy of the "proposed changes" for that meeting with the changes made and notes taken at that time.

It was distinctly understood that as the rule now stands it was to permit the two wiring plans, but the switch was only to be used for 660 watts or less.

Demands for Ship Tonnage Between Manila and United States.

Pacific Mail Steamship Company is making Manila, P. I., the distributing point for United States products destined for various places in the Far East. Lack of transportation facilities between Manila and other points in the Philippine Islands is reported serious, and Manila business interests have asked that the smaller German boats seized be allowed to remain there for local use. In external trade, cargo space is reported available for imports from North America, but shipments from the Philippines east are difficult to arrange because of over-crowded ships and excessive rates. This indicates tremendous demand for tonnage from the Far East across the Pacific. Similar conditions are experienced at Singapore and other points in the Straits Settlement. The principal Philippine products for export are hemp, sugar and cocoanut oil, and over 60 per cent of exports go to the United States.

LONGEST SPAN FOR POWER-TRANSMISSION LINES.

Shawinigan Power Company Building 100,000-Volt, 5000-Foot Span Across St. Lawrence River.

The rapid increase in power demand in the Province of Quebec during the last year or two, due to the manufacture of munitions of war and other materials not formerly produced in Canada, has impelled the Shawinigan Water & Power Company to undertake a record-breaking engineering feat—the spanning of the St. Lawrence River with a 100,000-volt transmission line, furnishing power and light to various towns. The construction of this transmission line entails the erection of two towers, which will support a 5000-foot span of three steel cables. This span is the longest of the kind known, says the *Journal of the Royal Society of Arts*, exceeding the 4427-foot span across the Carquinez Straits in California.

Towers will be necessary rising to the unusual height of 350 feet, the same elevation as the top of the Quebec Bridge. The height of the towers is fixed by the requirement of river navigation, the lowest point in the cable having to clear the water by 160 feet minimum. The towers rest on concrete foundations located in the river about 500 feet from each shore. These foundations consist of four circular concrete columns 11 feet in diameter, extending to a depth of 40 feet below the river bed and projecting 25 feet above it, thus being partly submerged. The four piers are tied together above the water level by arched concrete structures forming a square. The concrete foundations will be protected against the action of ice by a low crib dam located about 100 feet upstream, and arranged so that the ice will pile up and break in small pieces before it can reach the tower foundations. Into these four piers are to be anchored the four legs of the tower, which will be built of structural steel.

At the top the towers widen out into a platform, on which are mounted the supports for the three cables, which are to be of plow steel. These cable supports are all on the same elevation and placed in such a position as to keep the cables 50 feet apart, to prevent them from swinging together in the long span. The cables are not anchored at the supports, but are brought down on the back of the towers to an anchor in the ground at some distance behind the towers. The supports, however, are designed to allow a certain amount of movement to the cables, due to the expansion caused by changes in temperature.

In order to use the cables as conductors to carry current at 100,000 volts, it will be necessary to insert special insulators in them between the ground and the supports on the towers. The magnitude of this problem is better understood when it is realized that these insulators are not only subjected to extreme electric tension, but also to a mechanical stress of above 150,000 pounds each. The arrangement of insulators must allow the replacement of any parts that may become damaged through electric failure without interfering with the mechanical safety of the span. The insulator group will consist of an elaborate arrangement of porcelain units of a new type subjected to pressure only, and held together by an iron frame. It is hoped to have the whole project completed by the end of the summer.

QUESTIONS AND ANSWERS

All readers are invited to submit questions and answers to this department. Anonymous communications will not be considered. Questions should relate to electrical matters of any kind. Answers contributed by readers should be submitted preferably within eight days of the date of publication of the question and should be limited, if possible, to 300 words. Payment will be made for all answers published.

Questions.

No. 393.—MAINTENANCE OF UNDERGROUND LINES.—What has been the actual cost of the maintenance of underground cables, conduits, etc., for series street lighting at various voltages and different systems, exclusive of electrolier maintenance? What does this maintenance consist of?—T. S. P., San Francisco, Cal.

No. 395.—SHALLOW CONCEALED-PLUG FLUSH RECEPTACLES.—The owner of a house that I am wiring desires to have installed in the shelf of a mantle some flush receptacles so that the plug does not project above the surface. The shelf is only two inches thick and I am, therefore, at a loss to know just how to install this and have it concealed. The owner insists that he has seen many mantles with flush plugs in the shelves. The only solution I can think of would be to use a very shallow receptacle, but I do not know of any on the market that is shallow and at the same time conceals the plug. Is it possible to secure any receptacles of this sort? What is the accepted practice in a case of this kind?—F. J. E., Westburg, N. Y.

No. 398.—IRON-WIRE LINES.—On account of the high cost of copper it has been proposed to use iron wire more freely for rural light and power lines. What is the general experience with iron wire for this purpose? What kind and size of wire is most used? What is the maximum economical distance that a single-phase load of five kilowatts can be transmitted with iron wire at 2,300 volts? Is the upkeep very expensive? I will greatly appreciate any information on this subject.—H. S. C., Washington, D. C.

Answers.

No. 396.—STORAGE-BATTERY ELECTROLYTE.—I have heard conflicting statements regarding what specific gravity it is best to have for the acid electrolyte of lead storage batteries. Some persons advise a weak acid and others a strong acid. What is the best strength to use? What is the effect of having it too strong or too weak?—R. H. T., St. Louis, Mo.

Answer A.—The density of the electrolyte for the ordinary lead battery varies from 1.175 in a discharged battery, to 1.210 in a battery fully charged. In a motor-car battery, because of the smaller quantity of electrolyte used, the density should be higher, varying from 1.150 in a discharged battery to 1.275 in a battery fully charged.

Weak electrolyte would result in a loss of capacity, while an electrolyte which is too strong will injure the plates through overheating, especially while charging. —W. D., Boston, Mass.

Answer B.—The strength of an electrolyte depends upon the condition of the battery, that is, whether it is fully charged, fully discharged or in an intermediate condition. For a fully charged battery the customary specific gravity for stationary batteries is between 1.190 and 1.225 at 60 degrees Fahrenheit. Automobile batteries frequently employ a somewhat denser electrolyte, whose specific gravity varies between 1.270 and 1.300. As a battery discharges the density of the electrolyte likewise decreases. On no account should the specific gravity be allowed to drop below 1.150, the best minimum value probably being between 1.170 and 1.195 for electric vehicle batteries.

The strength of the electrolyte plays an important part in the operation and life of a battery. If the specific gravity is too high, excessive sulphation of the plates and accelerated deterioration of them occurs. The capacity, efficiency and voltage of a battery are all intimately affected by the density of the electrolyte as they are also upon the quantity used. The greater the quantity employed, within reason, the better the operation and performance of the battery. Ample electrolyte and rather low concentration (specific gravity of about 1.210 maximum and about 1.185 minimum) is probably best as to economical life and satisfactory performance.

The majority of battery manufacturers specify as to the density of electrolyte best suited to their product. It is advisable in all instances where not familiar with storage-battery engineering to adhere to the manufacturer's recommendations. Doing so will usually result in the more satisfactory operation and in any case saves trouble and loss where a guarantee is at stake.

While the density of the electrolyte is of vital importance in affecting the life and performance of a cell, so also is it imperative for best results that the electrolyte be pure. Distilled water should invariably be used initially or for makeup and also for replacing evaporation. Sulphuric acid made from sulphur should be used, that made from pyrites never on any account being employed because of the injurious substances it contains. Electrolyte should always be tested for impurities before being poured into a cell. The impurities generally looked for are nitrates, acetates, arsenic, iron, copper, mercury, chlorine and organic substances.

Where much electrolyte is used, economy will accrue by making it oneself instead of purchasing it from the battery manufacturer, thereby saving the cost of freight, profit, etc. This should be done, however, only where facilities exist for making up the electrolyte properly, which of course necessitates knowledge of the requirements in order that necessary precautions may be taken.—K. R., Chicago, Ill.

Answer C.—The main reason for the apparent conflicting statements concerning the proper strength of acid to use is occasioned by the recommendations of the different manufacturers, each of whom believes his special type of battery needs a little different treatment from those already on the market. As this question is asked, however, there appears to be a slight misunderstanding. The weak or strong acid does not cause other things to happen, since the condition of high or low specific gravity of the acid is itself the result of some abnormal condition in the cell. In other words, weak or strong acid is a result and *not* a cause.

In the following a range of 10 to 30 points on either side of the specific gravity given will closely approximate all conditions met with in all the different types of batteries in use today, whether starting and lighting, electric vehicle, central station, or otherwise, In starting, the most suitable full-strength acid to use for preparing the electrolyte should show a specific gravity of about 1.760 or 66 degrees Baume. In diluting this the acid should be poured into the water until the point 1.200 is reached. *Never* put the water into the acid!

The battery should now be charged to specific gravity 1.290 or 1.300. When the specific gravity and voltage remain constant over a period of 4 or 5 hours (longer on starting and lighting batteries) the charge is completed. The acid can then be adjusted by the addition of fairly strong acid to the cells which are reading low and water to those which are reading high. However, no acid should be added until you are

positive that there is no more acid in the plates to be thrown off. There is great danger in trying to bring the solution to the required specific gravity by adding more acid, because it frequently happens that a great deal more acid will be thrown off by the plates if a further charge is given. If this acid is allowed to remain in the plates (and it will if the solution specific gravity is 1.300, since the acid cannot be thrown off as readily against this high internal resistance, sulphation will take place and an increasingly bad condition of the plates will occur.

When discharging, the hydrometer should be watched and the discharge stopped when the acid reaches specific gravity 1.160 or thereabouts. At all events, it is wise to follow closely the manufacturer's recommendations on his own cells, since they are often designed with some special solution strength in mind. —A. A. B., Cleveland, O.

No. 397.—Glare-Free Automobile Headlights.—Has any uniformity of opinion been reached as to the best way to make headlights of automobiles free from glare?—M. S. D., Columbus, Ohio.

To say that there is any uniformity of opinion on the subject of the proper method of eliminating glare of automobile headlights would be inexact and misleading, since even the laws of the various states governing this feature are inexpressibly vague and indefinite. The one factor that so far has been the most potent cause of confusion in this respect is the varying definition which has been given to the word "glare." This, however, is quite unavoidable. What might be a very glaring light at 100 feet would be diffused at 200 feet, or what to one man would appear as unlawfully blinding to another would seem perfectly diffused. Not only does this result in confusion with respect to exact definition in laws which regulate headlights, but it also allows the motorist to exercise great latitude in conserving his own safety, by permitting him to illuminate the roadway as close to the legal limit of intensity as possible without transgressing the laws. This last is but natural when the dangers of night driving are considered.

Laying aside the purely psychological reasons for the ambiguity of present glare practice, we find that even technical experts of the Society of Automobile Engineers are divided over the correct system to use, even were it possible to reconcile the motorist's desires with laws of the various states. One system contemplates the use of diffused light, while the other deflects the light beam in such a way that there is no direct ray thrown in the eye of a person stepping in front of the machine.

To obtain a diffused light, use is made of the many so-called diffusers or patented lenses which are now on the market under the title of "non-glare" devices. With these, however, several disadvantages are at once apparent.

Primarily there will be definite change of light flux with the change of voltage. Even though the best diffusing lens made is used, this change of light intensity will make the determination of the proper amount of glare most difficult, and consequently the motorist is laid open to the charge of carrying glaring headlights, even though his lamps are equipped with an approved type of device. This illustrates the vagueness of the existing practice. While the car driver with this type of lens is assured of a non-glare headlight, he is at the same time deprived of that long-range road illumination which is so necessary for night driving. This diffused light is also so low in intensity that there is no warning beam thrown forward at road intersections or as a signal to motor parties drawn up alongside the road.

On the other hand, the manufacturers of such lenses naturally claim many advantages for them, all however boiling down to the fact that these lights are non-focusing and that therefore the constant adjustment and aiming of the headlight is done away with, while all the time there is always sufficient light near the car.

Many states have so worded their anti-glare laws that the deflection method of headlight control seems to be the most feasible way of compliance. This method contemplates the adjustment of the light so that there is no light thrown above a plane parallel to the ground and not more than 42 inches from it. The proper adjustment can, of course, be absolutely determined, this being one of the points in favor of such a system. At the same time all worry concerning a rise in light flux occurring with each change in voltage is eliminated. So long as the light rays do not project beyond the 42-inch limit, there is no limit to the intensity of light source which may be used. The long-range beam which is obtained with an exactly focused light makes night traveling safe by giving excellent distant-road illumination, and also acts as a sufficient warning beam in those cases stated above as lacking this feature with the diffusing light. These main advantages are supplemented by the favorable considerations that there is no glare close to the car, no expensive lenses are required, and that general compliance with existing ordinances is made much easier and more exact.

The only disadvantages which can be cited are: The light bulb must be in exact focus to give a clear light, and on rough roads there is some momentary glare when passing over ruts, the movement of the car raising the light above the prescribed 42-inch limit.

Right here it may be said that so long as lamp manufacturers are expected to place efficient sets of lights on cars for the prevailing low price, we can look for unsatisfactory progress in solving the problem.

A summation of the state of public opinion and legal requirements seems to indicate that the problem will always be difficult of solution as long as the motorist on the one hand endeavors to obtain the best road illumination possible, while the regulating authorities on the other hand are prescribing vague and indefinite laws regarding the amount of light permissible. In a word, such a condition is an impossibility, and is the direct cause of much of the confusion that has arisen concerning the elimination of headlight glare. The attempt to discover a method of absolutely eliminating glare without appreciably reducing the road illumination is bound to result in endless litigation and unthinking, if not intentional, breaking of the law. The ultimate solution must be a compromise in which the motorist sacrifices some of his intense road illumination, and at the same time is favored by the passage of sane, intelligible laws which can be easily interpreted by the average officer.

Lately a concentrated pilot light mounted on the side stanchion of the windshield and used as a supplement to the diffused headlights has been growing in favor. In this way the law of diffusion is complied with, and the motorist still has at hand a long-range light which can be moved about readily when there is need for the same. At all other times the pilot light can be directed on the road close to the front of the car in such a way that there is no glare above the prescribed 42-inch plane.—A. A. B., Cleveland, O.

New Electrical Appliances

A Review of the Latest Developments and Information Respecting Electrical and Kindred Mechanical Appliances

New Porcelain Pull Sockets.

For outdoor installations, cellars, in factories, etc., where a metal pull socket would be seriously damaged by the weather, or other corroding influences, the General Electric Company recommends its new porcelain pull socket, type G.E.639. These sockets take the

New Porcelain Pull Socket.

"standard" GE pull-socket interior and are therefore interchangeable in metal and porcelain shells. These sockets are furnished with ⅛ and ⅜-inch and pendent caps; 250 and 660 watts are the ratings.

New Devices for Cleat Wiring With Concealed Terminals.

The tendency of underwriters' interests is to prevent open contacts, as much as possible, on cleat wiring. The wiring code in many cities has been revised during the last year to include rules against exposed terminals on wiring devices for such use.

Most of the devices now on the market for cleat work have exposed terminals, and in the cases above referred to would not be acceptable.

The Arrow Electric Company, Hartford, Conn., has brought out two new devices for cleat wiring, with concealed terminals, one a plain, porcelain fuseless rosette, the other a base for the "Arrow 20" interchangeable brass-shell line.

With this base it is possible to make a complete line of sockets, key, keyless and pull, with all modifications, such as Arrolock, extension attachment, etc., also a complete line of pull switches, bottom outlet, rosette switches, etc.

Porcelain Fuseless Rosette With Concealed Terminals.

Base With Concealed Terminals for Interchangeable Sockets.

These two devices with the standard porcelain keyless cleat receptacles, No. 58,300 type, offer a complete group to meet the need which arises when the requirements for cleat wiring call for concealed terminals.

New Three-Pint Electric Percolator.

A new three-pint percolator pot is being marketed by the General Electric Company. This handsome percolator is of solid copper, heavily nickel-plated and polished. Both the pot and spout are made of formed metal so that there are no seams to open and cause leaks. The inside surface is coated with pure tin. The ebonized wooden handle with comfortable grip always remains cool. The biggin (or coffee container) and the pump are of aluminum and are combined in one part. These, together with the cover and the aluminum distributor which spreads the dripping water over the coffee, are removable.

The pump fits over a short tube which forms a steam chamber in the center of a casting in the bottom of the pot. The heating unit is clamped to a flat disk which forms the lower section of the casting. The heat is thus conducted directly to the short tube inside the pot, where it is concentrated against the steam chamber.

This percolator will make seven cups of clear and delicious coffee. It is very economical in its operation

New Three-Pint Electric Coffee Percolator.

and quite rapid. Within 90 seconds after the current is turned on steam is formed in the steam chamber and forces a jet of steam up through the pump tube.

Benjamin Automobile Headlight Reflector.

The problem of effective and satisfactory headlight lighting of automobiles is a very difficult one and on this very account has commanded the attention of almost numberless inventors. Elimination of glare is one of the chief difficulties encountered. At the same time the light must be powerful and directed so as to illuminate the roadway ahead of the car effectively and also furnish some illumination sideways for illuminating the edges of the road and adjoining ditches. Of the many solutions proposed various methods for dimming and diffusing the light have been tried out. The most competent engineers are agreed, however, that this is not the proper solution, because it inter-

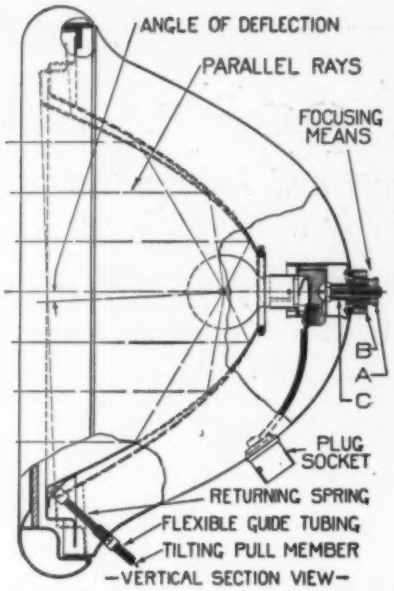


Fig. 1.—Vertical Section Through Headlight and Reflector.

feres with the proper direction of the light and at the same time is inefficient.

The general solution that seems to meet the requirements most effectively consists in providing a very powerful light, which is thrown upon the roadway in such a way as to confine the bright beam well below the horizontal plane through the headlight. A new method of doing this has been developed by the Benjamin Electric Manufacturing Company, 128 South Sangamon Street, Chicago. A special type of headlight reflector has been developed, which in its vertical section is a true parabola and in its horizontal section is somewhat elliptical. This special shape has been purposely chosen so as to increase the spread of the beam horizontally. The center of the lamp filament should be placed at the exact focus of the reflector, a focusing adjustment being provided for this purpose.

A vertical section of the reflector and complete headlight is shown in the accompanying Fig. 1, which shows that at the lower edge of the reflector there is provided a special pull member for tilting the reflector downward through a certain angle. This tilting is accomplished by means of an attachment placed directly below the steering wheel, so as to be always convenient to the driver. The reflector is pivoted on the horizontal axis passing through the lamp center. It is carefully balanced and held in normal position by a return spring. The angle of the beam is at all times under the instant control of the driver. It may be held manually at any desired angle within its limit of motion, or it may be tilted to the desired angle and fixed in this position by means of the locking lever shown in the elevation of the steering column and wheel in Fig. 2.

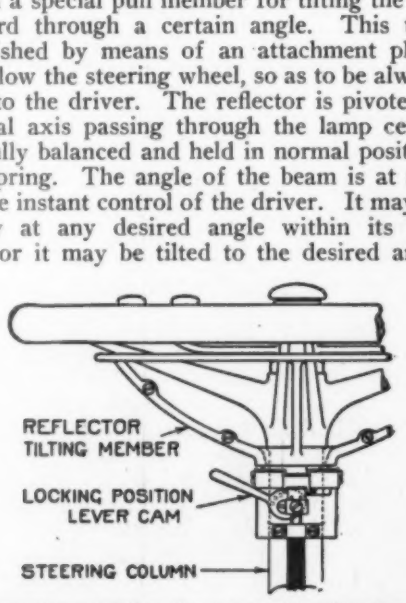


Fig. 2.—Mounting of Tilting Member and Locking Device Below Steering Wheel.

Fig. 3.—Illumination Obtained on Roadway.

In Fig. 3 is shown an illustration of the illumination obtained by means of headlights equipped with these reflectors. This cut was made from an unretouched photograph and shows the illumination with the reflectors at full angle of tip. The cars which are seen in the background are about 75 feet from the headlights. Each car is well illuminated and even the smallest irregularities in the road are disclosed by the brilliant lighting in the intermediate foreground. The beam is confined to the actual roadway and there is no glaring light above the fenders of the approaching cars. This eliminates the very serious objection that an opposing driver encounters when approaching a car with ordinary headlights throwing the full beam in horizontal direction. An advantage claimed for this type of reflector is that the character of the distribution is controlled entirely by the reflector shape and therefore neither the distribution nor the intensity of the light is disturbed in case the glass front of the headlight is broken, which, of course, is not true where a lens is depended upon for controlling the direction of the light.

Feed-Water Regulation for Boilers of Commonwealth Edison Stations.

The "S-C" Regulator Company, Fostoria, Ohio, has extensive works devoted exclusively to the manufacture of steam specialties, including the "S-C" continuous feed-water regulator and accessory equipment. Its Chicago office, at 1535 Lytton Building, is in charge of E. H. Bolton. The introduction of the "S-C" specialties, and particularly the feed-water regulator, in steam plants at Chicago and other cities has been coincident with tests and trials of efficiency. The sale of 158 of these feed-water regulators to the Commonwealth Edison Company, for use in three of its Chicago power stations, is an interesting story in trade circles. The several orders given by the latter company amounted to 104 3-inch, 24 2½-inch and 30 4-inch regulators. The 2½-inch size is adapted to boilers of about 650-horsepower, the 3-inch to 1250 to 1450-horsepower and the 4-inch size to boilers ranging from 1200 to 1900-horsepower. Of the 3-inch type, 48 are for the Commonwealth Edison's Quarry Street station, and 56 are for the Fisk Street plant; the 24 regulators of the 2½-inch size went also to the Fisk Street station; and of the 4-inch type, 11 were for the Fisk and 19 for the Northwest power station.

In 1913 a trial order was secured for one regulator, which was installed in Fisk Street station, where it has been in service four years. In 1916 two others were installed at the same station, where the chief engineer, A. D. Bailey, was putting these and other regulators to the severe test in which actual efficiency was the only thing that counted. Later in the same year the consulting engineers, Sargent & Lundy, ordered an "S-C" regulator for the Northwest station, and after using it several months placed an order for 19 regulators for the latter station and ordered 8 for the Fisk. This was followed by an order from the Commonwealth Edison Company direct for 56 more regulators for the Fisk station. This move then led to a final conclusion to equip the company's entire installations with "S-C" regulators, and orders were given accordingly. Mr. Bolton, the Chicago agent for the "S-C" company, has the satisfaction of having had his salesmanship reinforced by results after scientific tests, showing a mechanical feed-water regulator that feeds the boiler in proportion to evaporation, and feeds continuously in that exact proportion.

Sheck Universal Adapter for Changing Motion-Picture Projectors from Arc to Mazda Lamps.

For the projection of motion pictures, arc lamps have been used almost invariably since they provide a concentrated, powerful and easily focused light source. They have the serious disadvantages, however, of unsteadiness and of requiring a direct-current source to give the best results. Since the concentrated-filament type of tungsten lamp was developed, especially that known as the Mazda type C lamp, efforts have been made to utilize this lamp for projection purposes. Much study was given to the matter by the research laboratories of the lamp-manufacturing organizations. At the same time, development work was carried on to perfect a simple type of lamp mounting, together with focusing arrangement, etc.

The results of this combined development work have been completely successful. The lamp manufacturers have produced a form of Mazda lamp specially adapted for projection purposes. At the same time, a very convenient method of mounting and utilizing these lamps has been invented by Oscar M. Sheck, an electrical engineer of long experience in motion-picture projection and similar theatrical work. Mr. Sheck

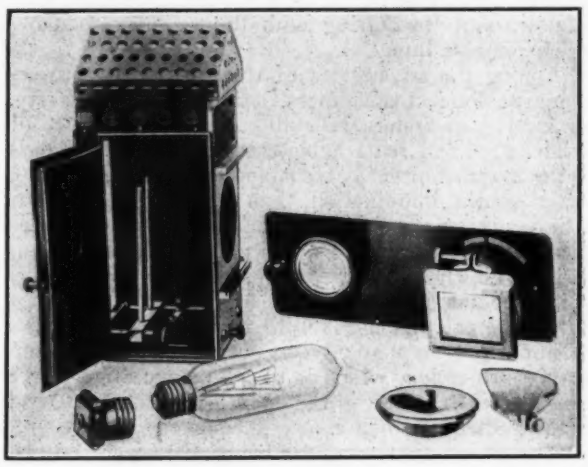


Fig. 2.—Parts of the Sheck Universal Adapter.

was one of the organizers of the International Alliance of Theatrical Stage Employees and Moving-Picture Machine Operators. The result of his work, on which patents are now pending, are known as the "Oscar Sheck Universal Projector Lamp Appliances" and the first of these being marketed is the Sheck Universal Adapter. Others will be brought out from time to time.

In bringing about the development of this device Mr. Sheck undertook to devise a simple equipment that could readily be installed in the ordinary arc-lamp projector housing. Such a housing is shown in Fig. 1, which makes clear the comparative complexity of regulating mechanism that the arc lamp requires. In Fig. 2 are shown the various parts forming the Sheck universal adapter. The completed new unit is shown in Fig. 3. A comparison of Figs. 1 and 3 shows very effectively the relative simplicity of the new device. In fact, after it is once installed it requires very little attention and the time of the operator can be devoted to more important matters than the constant adjustment of the mechanism which is required in the arc lamp. The new adapter can be fastened to any carbon-arc machine in a very short time; the manufacturer states that arc projecting machines can be equipped without interrupting the motion-picture pro-

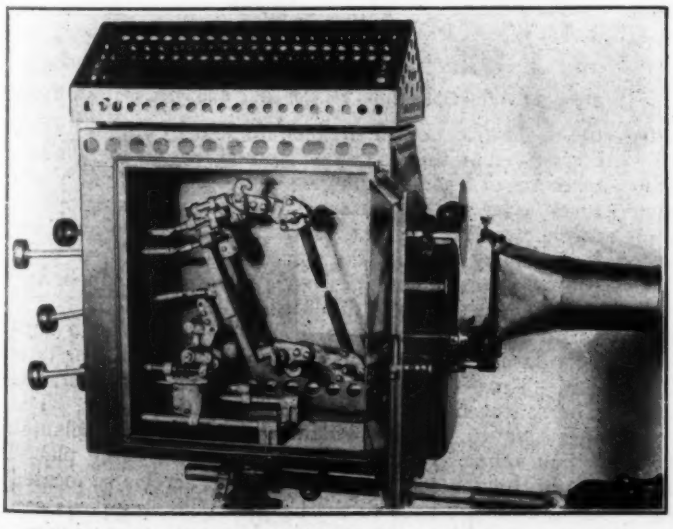


Fig. 1.—Typical Arc Lamp Projector for Motion-Picture Theaters.

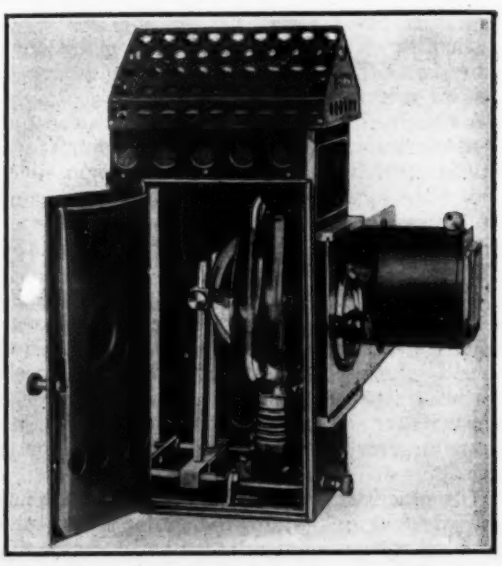


Fig. 3.—Sheck Universal Adapter Complete.

gram of any theater. The device is attached with four bolts without interfering with the arc-lamp housing which remains intact.

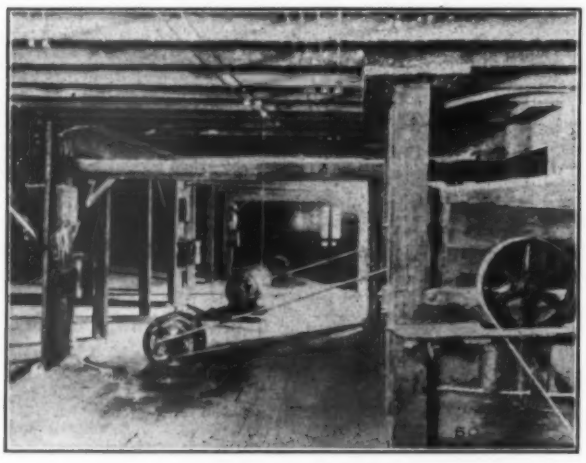
Among the advantages of this method of projection are: Perfect steadiness, quiet operation, safety, elimination of fumes, reliability, complete absence of flickering, and remarkable simplicity. These lamps do not require direct current and will give, it is said, better screen illumination than practically all alternating-current arc lamps. In fact, they can replace direct-current arc lamps up to almost the largest capacities, depending on the projecting conditions.

This combined development of the projector lamps and of the equipment for utilizing it effectively marks an important step in advance in the art of motion-picture projection, which is of advantage alike to the owner of the theater, to the operator of the lamp, and to the audience which comes to view the picture.

The Sheck appliances are being manufactured and sold exclusively by the Argus Lamp & Appliance Company, 322 Euclid Avenue, Cleveland, Ohio.

Demonstrating Reliability of Motor Drive.

A great deal has been said and written by authorities on the reliability of motor drive. Much of this discussion went over the head of the non-technical reader so that in spite of the widespread educational work many power users clung for years to the idea that the electric motor was not suitable for certain kinds of motor drive under trying conditions of dust, moisture, etc.



Lincoln Motors in Salt Factory.

It remained for one motor manufacturer to arrange a demonstration that proved beyond doubt the reliability of electric drive, under seemingly impossible handicaps. The example was so striking and convincing that it has done more to build up confidence in the electric motor than all the technical articles that have been written on this subject.

At a machinery exhibition in Cleveland in 1908, the Lincoln Electric Company exhibited one of its standard induction motors in constant operation while entirely submerged in water. This exhibit attracted such wide attention that the idea has been used by the company ever since, in many conventions and meetings of manufacturers and others interested in use of power.

The practical worth of this test has been proven in hundreds of cases where the motor in actual service has stood up under even more severe tests than submerging in water.

A good instance of this is a motor installation in the Cleveland Salt Works, Cleveland, O. Here the motors have operated in rooms where moist salt is always present and this salt has caked into the windings, until they are hardly visible. In spite of this there has not been a single shut-down from motor trouble in the ten years since the motors were installed.

Plants where dust has been a troublesome factor have become convinced in the same manner that the electric motor is the most reliable power for their work.

The Lincoln Electric Company, Cleveland, O., who developed this motor drive test, is manufacturer of induction motors from ½ to 500-horsepower. The unique demonstration has not only proven an important factor in its own business, but in the development of motor drive, generally.

Adjustable High-Tension Busbar Supports of the Unit Type.

It is often difficult or even impossible during initial engineering layouts for substations to show accurately the exact direction of the bus, number of angles, turns, etc. Even if these are determined, actual installation often necessitates a change. This calls for readily adjustable busbar supports. A line of universal supports now placed on the market has adjustable top and bottom elements so that the conductors can without difficulty be run at any desired angle to the supporting structure as shown in the left-hand illustration.

Group of Adjustable High-Tension Bus Supports of Unit Type.

In many installations it is also necessary to support buses from I-beams, and for this service the type VB, CB or TB have been found especially desirable. These are shown in the middle group of cuts. The insulator base is provided with adjustable clamps which securely grip the beam, and after being placed in position, is locked by means of set screws so located as to bind the base to the beam. These supports can be used to clamp to any size beam up to 24 inches,

thus covering an extremely wide range. At the right are shown three other "unit-type" supports of the adjustable pattern. They are designated as types IS, IV and IK, respectively.

These bus supports are made for all voltages up to 44,000. They are manufactured by the Delta-Star Electric Company, Chicago, Ill.

Economy of the Sign Flasher Worthy of Consideration During War Time.

By Walter Scott Ryan.

Now that our nation has embarked upon a war that may last for years, our resources of men and minerals will be drawn upon most heavily, and it therefore behooves all patriotic citizens to conserve these supplies as wisely as possible, but at the same time to avoid the "flare-back" economies that are so frequently advocated.

The "stay at homes" will have much to do with winning the war, but they must keep the wheels of industry turning. While there are many useless contraptions, like a vermiform appendix, attached to our industrial machine that should be removed, great care should be exercised that none of the grease cups or other parts of the lubricating system, or other essentials, be interfered with.

Our modern civilization is so very complex that the question of what should be eliminated is somewhat difficult to decide, and many good and useful products will be discontinued because at first glance they appear to be non-essentials. To illustrate this point I will state the question I was called upon to decide.

Part of my energies are devoted to the manufacture of the electric sign flasher—the little machine which causes the electric sign to wink and do so many spectacular "stunts," thereby making the sign exceedingly attractive.

One might say, at first, "Why not save the cost of this device, dispense with the added attraction, and allow the sign to burn steadily with a grim dignity, in keeping with the war times?" This seems, at first glance, to be a good argument in war economics, and I was possessed with the thought that, perhaps, part of my energies were being wasted. Before communicating this point of view to my associates I concluded to give the flasher a thorough "once over" and find some justification for its use. The results of my thoughts along this line were reduced to a few astounding figures.

One of the largest corporations in America has in use more than a thousand steady-burning electric signs. They burn on an average of seven hours every night during the year and consume during that time 2,250,000 kilowatt-hours. They are now equipping these signs as rapidly as possible with automatic flashers, which will flash them on for seven seconds and off for five seconds, thereby saving 5/12 of the current. Estimating that the central stations throughout the country consume an average of 2½ pounds coal for each kilowatt-hour, a total of 1053 long tons of coal will be saved by the use of these little machines.

As an additional example ofwhat two flashers will do, take the two electric signs recently erected on Broadway, that contain approximately 20,000 ten-watt lamps. These two signs will consume 511,000 kilowatt-hours per year, and if equipped with flashers a saving of 170,000 kilowatt-hours will result.

Regardless of the rate charged for energy, it should be borne in mind that it takes just as much coal to make a kilowatt for an electric sign as for an electric iron, as all kilowatts look alike to the coal pile. When it is considered that it is possible for two small flashers that cost less than $200 to save from 60 to 200 tons of coal per year, it is evident that every steady-burning electric sign is an extravagance that should be abated.

The foregoing figures prove that there is a duty devolving upon all manufacturers to give careful consideration to the usefulness of their varied products, and concentrate their energies on the labor savers and conservers of materials. In doing so their work will be fully as valuable to the nation as if they were on the firing line.

Electric Broiler for Hotel Kitchens.

Among the new devices from the heating department of the General Electric Company is a compact and remarkably efficient hotel broiler. This broiler is an open compartment of sheet steel with an angle-iron frame. A sheathed-iron heating unit, with two heats, consuming 2500 to 5000 watts, respectively, is located in the top of the broiling chamber. The top of the chamber is provided with two inches of heat-insulating material to prevent radiation of heat upwards. The heating unit is operated by a double-pole knife switch located on the top of the broiler. The broiler is furnished complete with a substantial drip pan and a gridiron, on which the meat is placed. The gridiron is supported below the unit on a movable frame which

Large-Capacity Electric Broiler for Hotel, Club and Restaurant Kitchen.

may be raised or lowered by means of a lever on the side of the broiler near the front. The gridiron can also be drawn out of the broiler for turning or removing the meats. An angle-iron stand for the broiler can be supplied at an extra cost. The dimensions are: Height over switch 30 inches, width 23 inches, depth 30 inches.

With this hotel broiler it is possible to broil about 36 steaks, an average of two pounds each, per hour. The radiant heating unit quickly sears the surface of the meats and retains all their juicy tenderness. The effective broiling area is 16 by 23 inches, which is sufficient for broiling 12 pounds of steak, 1½ inches thick, at one time.

The intense overhead heat of the electric broiler is instantly available at the turn of a switch and the sizzling steak is soon done to a turn. The radiant heat from the glowing coils above the meat promptly sears the surface of the steaks and chops so that all their tender juiciness is retained. With the overhead heat there is also no chance for drippings to catch fire and flare up to contaminate the meat, as is the case with the old methods of broiling.

Activities in the Trade

The Hazard Manufacturing Company, Wilkes-Barre, Pa., announces the appointment of George B. North as general sales manager with offices at 533 Canal Street, New York City.

The Ashland Electric Company, 1517 Haddon Avenue, Chicago, Ill., dealer in electric supplies, is conducting a special sale this month on black and white conduit in carload shipment or less. The Ashland company is one of the largest supply houses in Chicago and enjoys a large patronage in the Middle West. The company specializes in conduit, switches, wire and cable.

Edison Storage Battery Company, Orange, N. J., sends out Bulletin No. 819, illustrating and describing the Edison Portable Lighting Outfit, especially adapted to use in underground work. It is used to advantage in manhole work to afford the workman suitable light. The set is installed in a small steel box, and consists of a five-cell Edison storage battery, fully charged and ready for service, and two properly guarded 12-candle-power lamps with reflectors and 11-foot leads. One lamp can be used 20 hours on one complete battery charge. Both together will burn for 10 hours.

Duquesne Electric & Manufacturing Company, with principal office in Bessemer Building, and shops at Binder Street and P. R. R. East Liberty station, Pittsburgh, Pa., was recently incorporated with a capital stock of $50 000. A branch office recently was opened in the Marshall Building, Cleveland, Ohio, with W. L. Moorhead in charge. The company's shops are well equipped for rebuilding electrical machinery, such as motors, generators, mining locomotives, switchboards, gas and steam engines. The company has been operating over a year under the name of the Service Supply & Equipment Company. There is no change in the personnel of the organization. New machinery is handled and a line of switches and switchboards will be manufactured.

George Cutter Company, South Bend, Ind., announces the appointment of R. W. Ten Broeck and A. B. Sonneborn as sales representatives for the state of Michigan, having established offices at 426 Ford Building, Detroit. In connection with the sale of street and industrial lighting equipment, switches, panelboards, switchboards, cutout boxes and other products of the George Cutter Company, an engineering department will be maintained for the purpose of drawing plans and specifications for the installation of such equipment. Both Mr. Ten Broeck and Mr. Sonneborn are well known to the electrical trade, especially in the Detroit territory. The former was associated with the Packard Motor Company for a number of years, later with the Davis Slate & Manufacturing Company, and for the past two years with the Mutual Electric & Machine Company of Detroit. Mr. Sonneborn was connected with the latter company for three years and during the past year was district representative of the Detroit Electric Welder Company, of Lansing, Mich., with offices in Detroit.

Brooke, Smith & Moore, Inc., Detroit, Mich., has succeeded the Chamberlin Company of that city in the technical and general feature advertising line. William Chamberlin, who established the agency a number of years ago, sold his interest in the concern to become sales manager for Wilder Tanning Company, Waukegan, Ill. The new organization occupies the quarters of the old company, at 1201-2-3 Kresge building. Its active personnel comprises C. W. Brooke, G. C. Smith and D. W. Moore, all of whom are experienced in the publicity and sales promotion field. Mr. Brooke, president of the organization, formerly was sales and advertising engineer for Westinghouse Electric & Manufacturing Company, and later was sales manager for the Williams Gauge Company, Pittsburgh. He established an agency in Pittsburgh and while managing that business was advertising counsel for National Tube Company and other large concerns. The Pittsburgh Publicity Association was later organized, its affairs having been directed several years by him as secretary. Mr. Brooke acquired an interest in the Chamberlin Company, Detroit, two years ago. Mr. Smith, for the last three years connected with the Chamberlin Company, is an effective writer, and is experienced in the advertising and sales work. Mr. Moore has been identified with advertising the past seven years, having been at the head of the copy department of Campbell-Ewald Agency, Detroit, handling many important accounts, such as that of Hyatt Roller Bearing Company. In Los Angeles he was president of the Moore Advertising Company. He is especially experienced in preparing literature for dealer work, that which he did for the Dealers' Co-operative Division of Maxwell Motor Company having attracted wide attention. The concern's present clients include some of the best concerns, such as Detroit Twist Drill Company, McCord Manufacturing Company, Murphy Iron Works and Detroit Stove Works.

C. W. Brooke.

G. C. Smith.

D. W. Moore.

Latest Approved Fittings

The electrical fittings listed and described in this department have been approved by the Underwriters' Laboratories, Incorporated, after examination and tests conducted under standards of the National Electrical Code as recommended by the National Fire Protection Association

Receptacles, Medium Base.—General Electric Company, Schenectady, N. Y.

"G. E." metal-shell receptacles, pull, catalog No. GE721.

Listed June 22, 1917.

Rosettes, Fuseless.—The Arrow Electric Company, Hartford, Conn.

"Arrow E", 3 amperes, 250 volts, catalog Nos. 1795, 1796, FQ-201 to FQ-236 inclusive, FQ-259, Q-1 to Q-36 inclusive, Q-59.

Rosettes with pull-socket mechanisms, 3 amperes, 125 volts, 1 ampere, 250 volts, catalog Nos. FM-219 (8560), FM-220, FM-221 (8561), FM-222 (8588), FM-223, FM-224 (8562), FM-227 (8563), FM-228 (8597), FM-229 (8600), FM-230 (8564), FM-231 (8565), FM-232 (8605), FM-233 (8608), FM-234 (8611), FM-235 (8614), FM-236 (8617), FM-259, FN-219 to FN-236 inclusive, FN-259, M-19 (422), M-20, M-21 (395), M-22 (487), M-23, M-24 (423), M-27 (461), M-28 (496), M-29 (499), M-30 (424), M-31 (396), M-32 (176), M-33 (179), M-34 (182), M-35 (185), M-36 (188), M-59, N-19 to N-36 inclusive, N-59.

Listed June 26, 1917.

Rosettes, Fused-Link Type.—The Arrow Electric Company, Hartford, Conn.

"Arrow E." For use only in large mills in accordance with Rule 23*d* of the National Electrical Code. 2 amperes, 125 volts, catalog Nos. FM-238 (8567), FN-238, FQ-238, M-38 (415), N-38, Q-38.

Listed June 29, 1917.

Sockets, Medium Base.—The Bryant Electric Company, Bridgeport, Conn.

"Bryant" or "Perkins" metal-shell push socket, catalog No. 81.

Listed June 22, 1917.

Sockets, Medium Base.—General Electric Company, Schenectady, N. Y.

"G.E." porcelain-shell sockets.

Key, catalog Nos. GE815-817 inclusive.

Keyless, catalog Nos. GE819-821 inclusive.

Listed June 25, 1917.

Switches, Automatic—Magnetically Operated Type.—Automatic Switch Company, 4-6 White Street, New York, N. Y.

Automatic switch consisting of copper and carbon contacts operated by solenoid, circuit of which is controlled by push-button switches, thermostats, pressure-regulating switches or similar controlling appliances located at remote points. "Darrin."

5 to 500 amperes, 125-250 volts; 5 to 75 amperes, 600 volts, type D M S.

Listed July 6, 1917.

Switches, Flush, Push and Rotary.—The Bryant Electric Company, Bridgeport, Conn.

"Bryant" or "Perkins." Double-pole, catalog Nos. 606, 610, 2298, 2526, 2624. Panelboard switches for mounting directly on busbars, catalogs Nos. 2645, 2646.

Single-pole, catalog Nos. 605, 2295, 2525.

Three-way, catalog No. 2296.

Four-way, catalog No. 2297.

Listed June 12, 1917.

Switches, Flush, Push and Rotary.—Hart Manufacturing Company, Hartford, Conn.

"Diamond H." Double-pole, catalog Nos. 061, 1222.

Listed June 5, 1917.

Switches, Inclosed.—General Electric Company, Schenectady, N. Y.

Two and three-pole knife switches and cutout bases for standard cartridge inclosed fuses, inclosed in metal cases and designed for manual operation without opening cases. When cases are open, all accessible parts are dead.

"G.E." catalog Nos. 194802-10 inclusive, 200157-65 inclusive.

Listed June 8, 1917.

Switches, Inclosed.—The Johns-Pratt Company, Hartford, Conn.

Two and three-pole knife switches and cutout bases for plug fuses. Inclosed in metal cases and designed for manual operation without opening cases.

"Multiplex," two-pole, 30 amperes, 125 volts, catalog Nos. 10,606-08 inclusive, 10,612-14 inclusive. Three-pole, 30 amperes, 125 volts, catalog Nos. 10,609-11 inclusive, 10,615-17 inclusive.

Meter adapters for above. Catalog Nos. 10,479, 10,650-58 inclusive, 10,675-81 inclusive, 10,683, 10,684, 10,687.

Listed July 3, 1917.

Switches, Knife.—Barber Electric Manufacturing Company, North Attleboro, Mass.

"Barber." All standard ratings, types A and C.

Listed June 19, 1917.

Switches, Push and Rotary Flush.—General Electric Company, Schenectady, N. Y.

"G.E." Double-pole, catalog No. GE631.

Two-circuit, catalog No. GE635.

Three-circuit, catalog No. GE636.

Listed June 22, 1917.

Switches, Surface.—The Bryant Electric Company, Bridgeport, Conn.

"Bryant" or "Perkins." Series-multiple, 10 amperes, 250 volts, 15 amperes, 125 volts, catalog Nos. 2669, 2670; 15 amperes, 250 volts, 20 amperes, 125 volts, catalog Nos. 2672, 2673, 2679, 2680; 20 amperes, 250 volts, 30 amperes, 125 volts, catalog Nos. 2621, 2622, 2675, 2676.

Listed June 29, 1917.

Temperature-Regulating System.—Gold Car Heating & Lighting Company, 17 Battery Place, New York, N. Y.

Temperature-regulating device, consisting of solenoid-operated radiator valve and thermostat.

For use in maintaining predetermined temperatures at thermostat, and only when all wiring is installed in accordance with Class C rules of the National Electrical Code.

"Gold." 10 watts, 125-250 volts.

Listed February 8, 1917.

Wire Connectors.—Fahnestock Electric Company, Meadow Street, Long Island City, N. Y.

Spring binding posts, each consisting of a bent bronze spring with a slot through which a hooked tongue extends, the wire being held between spring and tongue.

"Fahnestock." Size A for wires of No. 10 B. & S. gauge and smaller; maximum current 30 amperes. Size B for wires of No. 14 B. & S. gauge and smaller; maximum current 15 amperes.

Standard as terminals of electrical appliances with ratings within above limits and which have been specifically submitted by and listed for their makers with these terminals.

Listed May 29, 1917.

Wire Connectors.—Walger Connector Company, Toronto, Ont., Canada.

Consists of a metal terminal plate with binding screws inclosed in a molded insulating composition sleeve, having threaded cap of same material.

"Walger" straight and three-way types. For use with wire no larger than No. 14 B. & S. gauge and only for connecting fixture wires to supply circuits at fixture outlets, and where open to view for connecting motor leads to supply circuits.

Listed May 19, 1917.

Personal and Biographical

F. A. NOYES has succeeded D. R. McDueffe as division superintendent for the Consumers' Power Company, with office at Saginaw, Michigan.

HARRY HOLLIS, electrical engineer for the Reading Transit Company, Reading, Pa., has resigned to accept a similar position with the Bethlehem Steel Company at Lebanon.

G. W. JOHNS, manager of the Boonton Gas Light & Improvement Company, Boonton, N. J., has resigned to become manager of the Newton Gas & Electric Company, at Newton, N. J.

J. W. KANE, formerly in the electrical engineering department of the General Electric Company, has been appointed superintendent of Fire Alarm Telegraphs, Newark, N. J., succeeding Adam Bosch, who had been in that service 41 years.

GEORGE SCOTT, chief engineer of power stations for the Moncton Tramways Electricity & Gas Company, Ltd., Moncton, N. B., has been appointed superintendent of the company, succeeding A. B. Coryell, the latter entering business at Buffalo, N. Y.

W. R. SHERRICK, former manager of the United Telephone system at Monroe, Wis., died at a hospital in Madison, August 7. He was 34 years old and an expert telephone man. He was at one time wire chief in the exchange at Duluth.

L. SHENLEY, electrical engineer with the Cornwall Ore Banks Company, Cornwall, Pa., has resigned to accept a position with the Westinghouse Electric & Mfg. Company. He will be succeeded by Manford Daugherty, heretofore assistant.

LAWRENCE N. SILER, a mechanical and electrical engineer of The J. G. White Management Corporation, New York, N. Y., has been assigned to the engineering staff of the Manila Electric Railroad & Light Company, Manila, P. I., which is being operated by the Management Corporation. Mr. Siler is a graduate of Cornell University.

R. B. STEARNS has resigned as vice-president of the Milwaukee Electric Railway & Light Company, Milwaukee, Wis., to accept the position of first vice-president of the Bay State Street Railway Company, Boston, Mass., and is preparing to assume his new duties September 1. Mr. Stearns had been in active charge of the business of the former company during the last six years. The Bay State Company operates about 1,000 miles of street and interurban railway in Massachusetts, New Hampshire and Rhode Island, all centering at Boston. It serves about 90 cities and towns. In the affairs of this company Mr. Stearns will have direct charge of the operation of all departments. While with the Milwaukee company he directed special improvements in facilities, standardized maintenance and promoted mutual benefit associations and other interests among employees, including various profit-sharing plans. It is said the offer from the Bay State company came as a surprise to Mr. Stearns, and its terms were so generous as to make its acceptance a matter of duty to himself. In the new position the duties probably will not be more difficult, though the responsibility will be much greater.

EDWARD L. FRANTZ has disposed of his interest in the Frantz Premier Company, Cleveland, Ohio, and resigned as vice-president and general manager, thereby severing all connection with the company. Mr. Frantz is the founder of that concern and one of the pioneers in the vacuum cleaner industry. Some years ago he recognized in the vacuum cleaner a device destined to become a necessity in every household, and proceeded to place the Premier electric suction cleaner on the market. Starting with a small, one-room factory he began manufacturing cleaners, and the product met with the instant approval of dealers and users. The business grew to large proportions, and the company soon occupied several thousand feet of floor space, and the name of the cleaner was changed to the Frantz Premier. Later the home now occupied was built for the business on Ivanhoe Road, where the industry was developed to its present magnitude. Mr. Frantz contemplates taking a well-earned vacation.

Edward L. Frantz.

W. J. LONGMORE, identified with Westinghouse Electric & Manufacturing Company, since 1881, and formerly local purchasing agent for the company at East Pittsburgh, has become general purchasing agent for the company, with offices at Pittsburgh, where he will supervise purchases as a whole, and specially direct those involving contracts for material used in electric works and shops. Charles G. Taylor, formerly assistant to Mr. Longmore at East Pittsburgh, is now purchasing agent for the works at East Pittsburgh, Shadyside, Cleveland and Newark. A. W. Fullerton, formerly purchasing agent for the Westinghouse Machine Company, now merged with Westinghouse Electric & Manufacturing Company, has been appointed purchasing agent of the machine works at East Pittsburgh, Trafford and Essington.

BENJAMIN F. HARDING, for the past year superintendent of the Bridgeton Gas Light Company, Bridgeton, N. J., and treasurer of the company, died July 21, at Atlantic City. He was a former member of the Bridgeton City Council and elder and treasurer of the Second Presbyterian Church of that city.

WILLIAM CLAPPER, traffic manager for the Interurban Railways, Des Moines, Iowa, has been promoted to the position of general manager. Mr. Clapper has been with this company since March, 1915, and formerly was division freight agent for the Wabash railroad at Des Moines.

R. M. BOYKEN has been elected vice-president and appointed general manager for the North Coast Power Company, Portland, Oregon, succeeding H. L. Harries, who resigned to enter the army. Mr. Boyken served the company as engineer for some time prior to his recent appointment. In that capacity he directed the engineering on important projects for the reclamation of overflow land on the Columbia and other rivers, and recently contributed to ELECTRICAL REVIEW an interesting article on features of that work, in which illustrations were given.

H. R. GORE has resigned his position as auditor of the Eastern Pennsylvania Railways Company, Pottsville, Pa., to accept a position with Haskins and Sells, public accountants, New York, N. Y. Prior to being assigned to that company he served as auditor of the Kentucky Public Service Company, Bowling Green, Ky., both of these utilities being under the management of the J. G. White Management Corporation, New York, N. Y.

MAJOR P. JUNKERSFELD, who in civil life is assistant to the vice-president of the Commonwealth Edison Company, Chicago, has been in very active service during the last two months in the capacity of supervising constructing quartermaster, in connection with the sixteen cantonments, being built for the new American army. Major Junkersfeld has just made a short visit to his office and explained that his duties consist in organizing the working forces at each cantonment visited. The requirements are for engineering work pertaining to such matters as water works, transportation and electric lighting. Plans for construction, and contracts for construction and supplies of material are arranged. Major Junkersfeld lately visited the cantonments at American Lake, Washington; Des Moines, Rockford, Dubuque and Battle Creek; and now his supervision extends to all the other training camps. Co-ordinate with supervising much of this stupendous work, of preparing war forces, is the making of reports to the military authorities.

Current Electrical News

WEEKLY RECORD OF CONSTRUCTION ACTIVITIES

EASTERN STATES.

PORTSMOUTH, N. H.—The Morley Button Company will build a one-story addition to its power plant for factory operation.

BROOKLYN, N. Y.—The Interborough Rapid Transit Company has had plans prepared for a one-story transformer station, about 50 by 100 feet, to be erected on Nostrand Avenue at a cost of $50,000.

ELMIRA, N. Y.—The Elmira Foundry Company will build a one-story transformer station, about 40 by 40 feet, to cost $10,000.

GENEVA, N. Y.—The Geneva Cutlery Company will build a one-story power plant at its works, about 60 by 120 feet, Torrey Park. William Summerhays & Son, 1 Exchange Street, Rochester, have the contract for erection.

JAMESTOWN, N. Y.—Panama Traction Company has been granted authority to issue stocks and bonds for funds to construct an electric railway from Ashville to Panama, in Chautauqua County.

NEW YORK, N. Y.—The Merchants' Power Company, New York, and the Memphis Consolidated Gas & Electric Company, both Delaware corporations, have filed notice of consolidation under the name of the Memphis Gas & Electric Company.

POUGHKEEPSIE, N. Y.—The Wallace Company, Main Street, has awarded a contract to Kingston & Campbell, 1 Washington Street, for a one-story brick and concrete heating plant at its factory, to cost about $25,000.

BAYONNE, N. J.—The Public Service Electric Company has been granted permission by the City Commission to extend its conduit system in a number of city streets. The company is also planning for improvements in the street-lighting system on lower Broadway.

BORDENTOWN, N. J.—To provide service at the new military cantonment at Wrightstown the Board of Public Utility Commissioners has approved the application of the Delaware & Atlantic Telegraph & Telephone Company to purchase facilities from the Farmers' Telephone Company in Florence, Mansfield and Bordentown Townships.

ESSEX FELLS, N. J.—The Committee on Street Lighting will receive bids up to 8 p. m., Aug. 24, for street-lighting for a period of five years from September 1, with 32-candlepower street lamps.

NEWARK, N. J.—The Board of Education will receive bids until August 22 for electrical equipment for the Essex County vocational schools, including one motor-generator set, with panels and auxiliary equipment, and electrical equipment for lighting shops. Wesley A. O'Leary, director.

NEWARK, N. J.—The Public Service Electric Company has awarded a contract for the construction of a switching station at its Essex power station, Point No Point.

NEWARK, N. J.—The Murphy Varnish Company has filed plans for the construction of a boiler plant at its factory on Bleecker Street.

TRENTON, N. J.—The City Commission has completed the installation of an ornamental lighting system in Mahlon Stacy Park, and inaugurated service.

TRENTON, N. J.—The Board of Managers, State Home for Boys, Jamesburg, has completed plans for the installation of power plant equipment at the school. F. H. Bent, State Capitol Building, is architect.

UNION HILL, N. J.—The Borough Council has approved an appropriation of $14,700 for street-lighting during the coming year.

UNION HILL, N. J.—The Union Town Council has passed an ordinance authorizing an appropriation of $23,000 for a fire and police telegraph signal system. Emil Bautz is town clerk.

BELLEVILLE, PA.—The Union Light, Heat & Power Company has made application to the Public Service Commission for permission to operate in a section of Union Township.

BLOOMSBURG, PA.—The local court has authorized the bondholders of the Columbia & Montour Electric Railways to foreclose on the property, consisting of about 18 miles of line. For the past year a receiver has been operating the company.

HARRISBURG, PA.—The Workmen's Non-partisan League has adopted resolutions favoring the establishment of a muncipal light, heat and power plant.

HARRISBURG, PA.—The city electrical department is arranging plans for the removal of all aerial lines in the Capital Park section and replacement by underground conduit lines.

JOHNSTOWN, PA.—The Johnstown Traction Company is planning for the extension of its lines in the Seventh and Seventeenth Wards, and in Coopersdale.

MILLERSBURG, PA.—The Millersburg Electric Light Company has completed the construction of a line from Millersburg to Halifax for lighting service. The line will be extended to Newport, Millerstown and vicinity.

MOUNT CARMEL, PA.—The Edison Electric Illuminating Company, recently acquired by new interests, will be consolidated, it is reported, with the Pennsylvania Lighting Company, operating at Shamokin and vicinity. The combined companies will serve Shamokin, Mount Carmel, Marion Heights, Locust Gap, Kulpmont and sections of Coal and Mount Carmel Townships, with total population of about 85,000. It is said that the new company is planning for expansion in its plants and system.

PHILADELPHIA, PA.—The John Lang Paper Company will build a one-story boiler plant, 50x100 feet, at its factory, Twenty-fourth and Wood Streets.

PHILADELPHIA, PA.—The William Freihofer Baking Company, Twentieth Street, will build a power plant in connection with its new three-story factory to be erected at Wilmington, Del. The Concrete Construction Company, 1620 Thompson Street, Philadelphia, has the contract for erection.

PHILADELPHIA, PA.—The United States Government is planning for improvements and extensions in the power plant at the Frankford Arsenal, to cost about $100,000.

PHILADELPHIA, PA.—In connection with line extensions and improvements at its different terminals, to cost about $8,000,000, the Philadelphia & Reading Railroad is planning for the construction of a new power plant at its local yards. A new coaling station will also be erected.

PITTSBURGH, PA.—The Rex Hide & Rubber Company, East Brady, will build a power plant in connection with a new factory building. The W. E. Moore Company, Union Bank Building, is engineer.

PITTSBURGH, PA.—The Duquesne Light Company has awarded a contract for the erection of a one-story addition to its substation, about 24x25 feet.

PITTSTON, PA.—The Public Service Commission has issued certificates of public convenience to the Jenkins Township Electric Light & Power Company for operation.

POTTSVILLE, PA.—The Eastern Pennsylvania Railways Company is arranging for the rebuilding of its electric power plant at Palo Alto, recently destroyed by fire. The J. G. White Engineering Company, New York City, will probably be in charge of the work.

READING, PA.—The Metropolitan Electric Company is making rapid progress in the construction of a new transmission line from its West Reading power station to Lebanon. The line will carry 33,000 volts and will be used for light and power service. Upon completion, the present Lebanon power plant will be employed as a substation.

SOUTH WAVERLY, PA.—The Borough Council has awarded a five-year street-lighting contract to the Sayre Electric Company, covering 80-candlepower lamps. The company has heretofore been furnishing service to the town.

BALTIMORE, MD.—The Consolidated Gas, Electric Light & Power Company will furnish electric power for the new factory of the Burnett Bag & Burlap Company, Brooklyn, Anne Arundel County. A special transmission line has been constructed to the plant.

ELKTON, MD.—The Chesapeake & Potomac Telephone Company will build a new two-story telephone exchange at Bridge and High Streets, to cost about $10,000. The company is also planning for improvements and extensions at Fairmont, W. Va., and vicinity, to cost about $200,000.

RICHMOND, VA.—The Virginia Medical College is planning for the construction of a new two-story power station. Nolan & Baskerville, Travelers' Building, are architects.

CHARLESTON, W. VA.—The Monongahela Valley Traction Company has increased its capital from $12,500,000 to $16,000,000 for extensions and betterments.

Can't Stop Business

There is no stopping business in this country—it's got to go on. It will go on, in spite of all gloomy talk, in spite of agitators, in spite of anything legislation can do to discourage capital. The reason that it has to go on is because it is bigger than any obstacle in its path. You can't force bad times on this country. We are going ahead, irresistibly, by force of our own resources.—Charles M. Schwab.

MARLINTON, W. VA.—Bonds for $20,000 have been voted by the Town Council for an electric lighting plant and water system.

MORGANTOWN, W. VA.—The West Virginia Traction & Electric Company is making rapid progress in the construction of a new transmission line in the Morgantown district.

BADIN, N. C.—The Aluminum Company of America, Pittsburgh, is planning for the construction of a new power plant at its local works, to consist of three 10,000-horsepower hydroelectric generating units. A new dam will also be constructed at Yadkin Falls to furnish the necessary head.

GOLDSBORO, N. C.—D. M. Prince and associates are planning for the electric operation of a cotton-ginning plant to be erected. Equipment for this purpose will be purchased.

MOCKSVILLE, N. C.—The city officials are planning for a bond issue for the installation of a municipal electric plant.

ORIENTAL, N. C.—Bonds amounting to $5,000 will be issued and sold to construct an electric light plant. J. C Ward, clerk.

SOUTHPORT, N. C.—The city officials are planning for the construction of a power plant.

GREENVILLE, S. C.—Huntington & Guerry have been awarded a contract for the installation of an electric lighting system at military camp Wadsworth. The company has also received a contract for the construction of a similar system at Camp Sevier.

CARTERSVILLE, GA.—The Thompson-Weinman Company is planning for the installation of motor equipment for the electric operation of machinery at its barytes mines. Power will be furnished by the Georgia Railway & Power Company.

ROME, GA.—The Matthews Iron & Steel Company is planning for the installation of new electric furnace equipment at its steel plant. Y. A. Dyer is general manager.

PALM BEACH, FLA.—Bonds amounting to $50,000 were voted to raise funds for street lighting, fire equipment, sewer system and to build an incinerator

NORTH CENTRAL STATES.

BELLEVILLE, O.—Electric lighting facilities are to be installed by the Ohio Light & Power Company.

BOWLING GREEN, O.—Ohio Northern Public Service Company is improving its power plant at a cost of about $50,000.

NEW PHILADELPHIA, O.—Ohio Service Company has a contract to supply power to the Greer Steel Company, Dover; also, to furnish power to operate a new 2,000-kilowatt electric furnace at the Reeves steel plant. The service company is installing a new 500-horsepower boiler, and a new steam turbine recently was put in operation.

CHICAGO, ILL.—General Electric Company, which acquired ground 24 by 198 feet at Harrison Street and Oakley Avenue, and 124 by 198 feet at Flournoy and Oakley, will erect a warehouse.

GREENVILLE, MICH.—Atlas Electric Storage Battery Company, to specialize in storage batteries for all purposes, has been organized, with following officers: Wm. Petschel, Chicago, president; H. P. Belknap, Grand Rapids, vice-president; R. H. Ozer, Chicago, vice-president; R. C. Ecker, Greenville, secretary-treasurer; J. S. Gibson, L. S. Kemp and H. L. Baker, directors. The company is to build and equip a plant.

ANTIGO, WIS.—Antigo Electric Company's newly elected officers are as follows: John Manser, Wausau, president; F. C. Boyce, Wausau, vice-president; F. A. Hecker, secretary-treasurer and general manager. These officers, together with T. W. Hogan and J. A. Cody, are directors.

BERLIN, WIS.—Plants of the Wisconsin Power, Light & Heat Company at Berlin, Neshkoro, Wautoma, Omro, Red Granite and Spring Lake have been sold to the Samsell interests, the latter being closely allied to the Commonwealth Edison Company, Chicago.

GREEN BAY, WIS.—Green Bay & Eastern Railway Company has increased its capital stock to $3,000,000 and will build a road from Green Bay to Manitowoc and Sheboygan.

LUXEMBURG, WIS.—This town wants electric light service. The formation of a company to build a plant is advocated.

DATES AHEAD.

Association of Iron and Steel Electrical Engineers. Eleventh annual convention, Philadelphia, Pa., Bellevue-Stratford Hotel, September 10 to 14. Secretary, J. F. Kelly, National Tube Company, McKeesport, Pa.

International Association of Municipal Electricians. Annual convention, Niagara Falls, N. Y., September 11 to 14. Secretary, Clarence R. George, Houston, Texas.

Northwest Section, National Electric Light Association. Annual convention, Spokane, Wash., September 12 to 15. Secretary, J. F. Farquhar, Washington Water Power Company, Spokane, Wash.

Colorado Electric Light, Power and Railway Association. Annual convention, Colorado Springs, Colo., September 20-22. Secretary, T. F. Kennedy, 900 15th Street, Denver, Colo.

American Electrochemical Society. Annual convention, Pittsburgh, Pa., October 3 to 6. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

National Electrical Contractors' Association of the United States. Annual convention, New Orleans, La., October 10 to 13. Secretary, H. C. Brown, Utica, N. Y.

It is also suggested that a connection be made with the High Falls Electric Power Company's system.

MARINETTE, WIS.—Rebuilding the telephone system is in progress under direction of Lyman Green. Improvements will cost $50,000. Two new circuits will be put in from Powers to Iron Mountain, and two from the latter to Norway, Iron Mountain and Crystal Falls will also be connected.

MILWAUKEE, WIS.—Issue of $750,000 of municipal electric light bonds is ready for sale. Proceeds will be for completing the light-distributing system.

NEENAH, WIS.—A municipal lighting system probably will be established. Tentative plans have been prepared by City Engineer McMahon.

RACINE, WIS.—Wisconsin Gas & Electric Company is selling a stock issue, face value of $500,000, to local investors, at $100 for cash or $102 on the ten-payment plan. Annual dividends are $7 per share. Money thus realized is to be used in making extensions of present utility service.

SUPERIOR, WIS.—Great Northern Power Company is planning construction of a 13,000-volt transmission line.

MINNEAPOLIS, MINN.—The Air Reduction Company, New York City, has purchased the plant of Northern Welding Company, Minneapolis, and that of the Duluth Gas Company, Duluth, at an aggregate cost of $400,000. The Minneapolis plant output will be increased. The purchase included the interests of Vulcan Process Company, which will be handled by the Air Reduction Sales Company. The oxy-acetylene and carbide products will be greatly increased.

CLERMONT, IA.—Northeast Iowa Power Company is improving its plants for increased service at Clermont and Volga. At former place a 350-horsepower Corliss engine, a 200-kilowatt generator and a 200-horsepower boiler will be installed, and the water power is to be increased 20 per cent. At Volga a water wheel and 100-kilowatt generator are being put in to supplement existing equipment, making a plant of 150 kilowatts. A transmission line is being built from Elgin to Wadena to supply those towns with light and power. Similar lines will be extended to the county farm, Randalia, Donnan, Alpha, Waucoma and St. Lucas.

MONDAMIN, IA.—Voters accepted proposal to issue $12,000 in bonds for funds to build electric light and power plant.

MUSCATINE, IA.—Iowa Railway & Light Company has asked for a franchise for the erection of a transmission line for lighting, power and heating.

KANSAS CITY, MO.—W. W. Winner has plans for building a 9-mile electric railway to Leeds, Mo.

PAOLA, KANS.—At a recent election electric light and water works bonds amounting to $30,000 were voted. G. P. Taylor, consulting engineer, Stockton, prepared plans for the plants.

CHADRON, NEB.—Nebraska & Wyoming Telephone Company is rebuilding its line between Chadron and Crawford, and a new switchboard has been installed at Crawford.

RIVERTON, NEB.—A bond issue for the installation of an electric lighting plant has been authorized.

BONESTEEL, S. D.—The proposition to issue $15,000 for the installation of an electric light plant was accepted by voters.

PIEDMONT, S. D.—Dakota Power Company, whose transmission lines were extended to this place over a year ago, supplies electric power to operate the mill of the United States Gypsum Company, and supplies light to Piedmont.

SOUTH CENTRAL STATES.

HOPKINSVILLE, KY.—The Kentucky Public Service Company is erecting a white way system on Main Street from Fifth to Twelfth and on Ninth Street between the two depots. Sixty-three posts will be installed and the arc lights discontinued.

KIRKVILLE, KY.—The United States Government will soon call for bids for the construction of a new one-story power plant at the Kirkville station.

LOUISVILLE, KY.—Aetna Refining Company is to erect an oil refining plant at a cost of $500,000, to handle the product of the Estill County oil district. J. King Duffy, New York, is president of the company.

MIDDLESBORO, KY.—The Kentucky Utilities Company has purchased the Middlesboro waterworks. The plant is designed to supply a city of 200,000.

MURRAY, KY.—The city electric plant and water works are about completed and will soon be in operation.

WHITESBORO, KY.—The East Kentucky Power, Light & Saw Company is planning for the construction of a new steam operated electric plant.

SOUTH PORTSMOUTH, KY.—The Federal Government will erect a power house at Dam No. 31, Ohio River, and will receive bids at the United States Engineer's office, Cincinnati, until August 31.

CLARKSVILLE, TENN.—The Chamber of Commerce has named a committee, including H. D. Pettus, A. B. Rollow and others, to devise ways and means for establishing a white way system and other civic improvements.

COLUMBIA, TENN.—The Columbia Water & Light Company is planning for the rebuilding of the section of its power station recently destroyed by fire. New generating equipment will be installed.

PULASKI, TENN.—The Pulaski Electric & Water Company, recently organized, is planning for the operation of a local electric power plant.

WILDER, TENN.—The Albert Amusement Company is planning for the construction of an electric plant for light and power service.

FT. SMITH, ARK.—Ft. Smith Light & Traction Company has plans for erecting an additional electric power plant, either here or on the Poteau River in Oklahoma. The proposed plant will have a capacity of 5,000 horsepower.

DAYTON, TEX.—Dayton & Goose Creek Railway Company has been incorporated to build 25 miles of road to Goose Creek oil fields. R. S. Sterling is identified with project.

EL PASO, TEX.—The El Paso Electric Railway Company has applied for a franchise to operate in this place.

KRUM, TEX.—The electric light and water works plant belonging to K. Sprouse has been destroyed by fire.

TERRELL, TEX.—The plant of the Terrell Electric Light Company has been purchased by Fred M. Leigh, Jr., of Galveston, and associates. The holdings include a power transmission line that runs from Terrell to Forney. K. E. Mason is general manager. He stated that the plant will be rebuilt and new machinery and other equipment installed.

WESTERN STATES.

TERRY, MONT.—Franchise has been granted to the Terry Improvement Company to install street lights.

COLORADO SPRINGS, COLO.—El Paso County Mutual Telephone Company will construct a line east to county boundary, a distance of 16 miles. W. E. McClung, acting president.

CARRIZOZO, N. M.—Council has au-

thorized Mayor Lutz to arrange with Lincoln Light & Power Company for power and light service. Steel towers will be erected to carry the transmission line.

LAS CRUCES, N. M.—H. M. Gray, Las Cruces, and associates are promoting the construction of an interurban electric railway to run between Las Cruces and El Paso, a distance of 44 miles. The proposed line will run through the irrigated portion of the Rio Grande Valley, which is thickly populated. It is said that financial arrangements have been made and that the work will be started as soon as the survey is finished and the right of way obtained.

MOGOLLON, N. M.—Fire destroyed the Telephone Exchange at this place.

POCATELLO, IDAHO.—The Salt Lake City International Electric Company has opened a branch in this place.

AMERICAN LAKE, WASH.—An army hospital will be built at a cost of $1,000,000, and in which $9,000 will be spent for electric light and power equipment. Address Maj. G. M. McGruder, Portland, Ore.

NORTHPORT, WASH. — Northport Power & Light Company, it is reported, will spend $150,000 for equipment and transmission lines to supply electric power for the smelter at this place and for mines in this vicinity. It is proposed to buy current from the West Kootenai Power & Light Company, whose plant is at the boundary. Electric power will supplant steam at the smelter. The directors are L. A. Campbell, Rossland, B. C., O. C. Moore, Spokane, and H. R. Williams, Colville, Wash.

PASCO, WASH.—The Pacific Power & Light Company is soon to install a new central switching station for the 66,000-volt system, at an approximate cost of $100,000.

TACOMA, WASH.—City Council has taken an option on Lake Cushman, which if finally purchased will be used as a power site for a plant as an adjunct to existing power facilities. This site is owned by Mason County Power Company, which asks $400,000 for it. The option runs for 60 days. The Milwaukee railroad has asked for 8,000 kilowatts by September 1, and the American Nitrogen Products Company, whose plant is at LaGrande, wants an additional 3,000 kilowatts by the same date. It is possible to develop 46,000 kilowatts at Lake Cushman, and a plant of that capacity would cost $2,500,000. A 45-mile transmission line would be required.

ASTORIA, ORE.—The contract for furnishing 13 electric motors, of about 600 horsepower, for the port docks, was awarded to the Westinghouse Electric & Manufacturing Company.

HELIX, ORE.—The Council has signed a contract with the Pacific Light & Power Company for the lighting of the city for a period of five years.

PENDLETON, ORE.—The Council has adopted plans for a lighting system for the entire city and has agreed to make a five-year contract with the Pacific Power & Light Company.

CHOWCHILLA, CAL.—San Joaquin Light & Power Corporation will extend its transmission lines 20 miles into the country to serve extensive farming interests. Paul Wilson is district manager at Madera.

FRESNO, CAL.—Davenport & Kleiser have sold out their stock to the Electric Laboratories of this place.

LOS ANGELES, CAL.—The Southern California Telephone Company announces that an additional sum of $175,770 has been set aside for improvements.

LOS ANGELES, CAL.—Bids are being received by the Board of Public Works for 10,000 ten-ampere, 10,000 fifteen-ampere, 5,000 twenty-ampere, 5,000 twenty-five-ampere, and 5,000 thirty-ampere, Edison base brasscap plug fuses, with mica windows, for 125-volt circuits.

ONTARIO, CAL.—It is announced that the work of closing the gap between Glendora and San Dimas will soon be started by the Pacific Electric Railway.

OROVILLE, CAL.—Pacific Gas & Electric Company will spend $50,000 improving its utility service in Oroville.

PLACERVILLE, CAL.—The Western States Gas & Electric Company has increased its force from 40 to 120 men in its efforts to complete certain parts of its power project before winter sets in.

SAN DIEGO, CAL.—The A. J. Savage Munition Company will erect a factory. The structure will cost $45,000 and the machinery $225,000. Electric power equipment will be installed.

SAN FRANCISCO, CAL.—The Calistoga Electric Company and the California Telephone Company have filed a supplemental application with the California Railroad Commission wherein the former asks for authority to sell to the latter its electric properties for $28,900.

SAN FRANCISCO, CAL.—The San Diego Consolidated Gas & Electric Company has asked for authority to sell $119,000 first mortgage 5-per-cent gold bonds and $114,300 preferred stock, and also from time to time in the next year to issue additional bonds to the amount of $373,000 and additional preferred stock $231,200, these sums to be expended in bettering and enlarging the company's system.

SAN FRANCISCO, CAL.—The Delta Telephone & Telegraph Company and the New Freeport Telephone & Telegraph Company have asked the Railroad Commission for authority for the former to buy the telephone system of the latter for $95,300 in stock.

RICHMOND, CAL.—Although the Southern Pacific Company's franchise for an electric railway on Cutting Boulevard expired last year, the city attorney states the company is preparing to go ahead with this work.

SAN FRANCISCO, CAL.—The Sierra & San Francisco Power Company has applied for authority to reimburse its treasury $30,000 for expenditure in part payment of a 9,000-kilowatt turbine and auxiliaries and to pay out $50,000 on machinery.

SAN FRANCISCO, CAL.—The California Utilities Company has been incorporated with a capital of $100,000 by W. M. Hunter, C. H. Mathison, N. Waldmeyer, J. A. Phelps and E. R. Ramsey.

SAUSALITO, CAL.—This city has sold a telephone franchise to the Pacific Telephone & Telegraph Company.

COBALT, ONT., CANADA.—Kirkland Lake Gold Mining Company has decided to build a concentrating mill and electric substation, current to be supplied by the Northern Ontario Light & Power Company, which has extended a transmission line to the district. Kirkland Lake is 70 miles north of Cobalt.

VANCOUVER, B. C.—Warnow, Farleigh & Company have made application to change the name of the firm to the United Electric Company, Ltd.

PROPOSALS

FILTRATION AND PUMPING PLANTS—Batesville, Ark., will receive bids until August 21 for filter building, filtration plant and a centrifugal pump and motor of 750-gallons per minute capacity. Address F. L. Wilcox, engineer, Syndicate Trust building, St. Louis, Mo.

POWER HOUSE—Commissioner of Corrections, New York City, will receive bids until Aug. 30 for construction of power house, tunnels and chimneys at New Hampton.

ELECTRIC PUMP AND CABLE—General purchasing officer for Panama Canal, Washington, D. C., will receive bids until Aug. 24 for furnishing material, including motor pump, hose wagon, motor, electric cable, valves and electric-driven equipment.

BUILDINGS, WITH ELECTRIC LIGHTING—Bureau of Yards and Docks, Navy Department, Washington, D. C., will receive bids until Aug. 27, 1917, for the construction of six 2-story steel-frame buildings at naval depots: two at Hingham, Mass., two at Lake Demark, N. J., one at Ft. Mifflin, Pa., and one at St. Julien's Creek, Va. All to be equipped for electric lighting and lightning protection. See specifications No. 2427.

MOTOR-DRIVEN SHOP TOOLS—Bureau of Supplies and Accounts, Navy Department, Washington, D. C., has asked for bids for the following equipment under schedules given herewith: One motor-driven radial drill, delivery at Mare Island, Cal., schedule 1396; one motor-driven engine lathe, delivery at Fort Mifflin, Pa., schedule 1400: one motor-driven, turret, 24-inch lathe, delivery at Fort Mifflin, Pa., schedule 1400; one motor-driven centrifugal pump, delivery at Norfolk, Va., schedule 1397.

INCORPORATIONS

OTTAWA, ILL.—The LaSalle County Electric Railway Company has been organized with a capital of $400,000.

TULSA, OKLA.—The Grand River Hydro-Electric Company, Tulsa. Capital stock, $10,000. Incorporators: H. C. Holderman, Tulsa; C. H. Fernstermacher, Tulsa; J. H. Rothammer, Tulsa.

SPRINGDALE, ARK.—The Springfield Light & Power Company of Springdale, capitalized at $50,000. Their incorporators are: George D. Locke, president; F. L. O'Neal, vice-president; H. L. Hughes, secretary and treasurer.

MIAMI, OKLA.—Neosho Power Company, Miami. Capital stock, $500,000. Incorporators: E. M. Stapleton, Oklahoma City; J. E. Parker, Oklahoma City; Henry E. Asp, Oklahoma City.

FRANKFORT, IND.—Beard Co-operative Telephone Company, Frankfort, Ind. Capital, $1,500. To maintain and operate telephones and exchanges. Directors: William E. Rice, Dessie A. Catron, John M. R. Henricks, P. A. Thomas.

MANNINGTON, W. VA.—The Mannington Plumbing & Electric Supply Company. Capital, $10,000. To manufacture electrical supplies. Incorporators: C. F. Peard, W. J. Leahy and D. A. Fitzgerald.

HONAKER, VA.—The Honaker Light Company. Nominal capital, $5,000. To operate a local electric lighting system. Incorporators: C. W. Hurt and G. B. Johnson.

DAYTONA, FLA.—The Daytona Electric Company. Nominal capital, $5,000. To manufacture electric fixtures. Incorporators: J. B. Garrison, S. B. Garrison and B. V. Markham.

CASEY, IA.—The Casey Mutual Telephone Company has been incorporated.

Patents Expired.

The following United States electrical patents expired on August 14, 1917:

655,703. Device for Registering Electric Currents. V. G. Fuller, Toulon, Ill.

655,716. Telegraphic Relay. I. Kitsee. Philadelphia, Pa.

655,747. Electro-Medical Vacuum Apparatus. G. W. Winckfield, Alameda, Cal.

655,762. Insulated Hanger for Arc Lamps. G. Cutter, Chicago, Ill.

655,763. Annunciator. W. M. Davis, Chicago, Ill.

655,769. Storage Battery. G. A. Ford, Cleveland, O.

655,772. Telephone Toll Apparatus. W. A. Foss, Cleveland, O.

655,777. Electrical Sign and Signal and Apparatus for Operating Same. A. Heiny, San Francisco, Cal.

655,779. Control of Electric Furnaces. W. S. Horry, New York, N. Y.

655,780. Electric Furnace. W. S. Horry.

655,783. Electrolytic Apparatus for Decomposing Metallic Salts. C. Kellner, Vienna, Austria-Hungary.

655,808. Electric Arc Lamp. B. A. Stowe, Cleveland, O.

655,809. Signaling Apparatus and Circuit Therefor. A. Stromberg and A. Carlson, Chicago, Ill.

655,810 and 655,811. Telephone-Exchange System. A. Stromberg and W. M. Davis, Chicago, Ill.

655,838. Method of Insulating Electric Conductors. N. Tesla, New York, N. Y.

655,849. Telephone Bell Cutout. L. F. Cobb, Providence, R. I.

655,852. Electric Motor. P. J. Collins, Scranton, Pa.

655,883. Receptacle for Secondary Batteries. J. Middleby, Jr., Malden, Mass.

655,905. Wire Joint and Method of Manufacturing Same. F. W. Maxstadt, Chicago, Ill.

655,916. System for Individual Service on Electrical Party Lines. W. Torst, Jr., Los Angeles, Cal.

655,920. Manufacture of Carbon. W. J. Burke, Scranton, Pa.

655,968. Voltaic Cell. E. M. Fishell, Cleveland, O.

Financial News and Gossip

The general business of the country has recently been undergoing some readjustment incidental to our participation in the war and the financing of the Liberty Loan; but by the time the crops begin to move to market this Fall, this readjustment will be completed and business, which even now is on the largest scale in our history, will undoubtedly further increase in volume until it reaches unprecedented and unheard of proportions.

INVESTMENT CONDITIONS.

While the war lasts there is sure to be more or less speculation in the stocks of industries supplying war commodities. The prices of those stocks may go considerably higher than present quotations, but at the first definite sign of peace they are sure to suffer severe declines. High-grade bonds yielding 5½ per cent and over are now in good demand, but low interest yielding municipal and railroad bonds are meeting with slow sale and have been steadily declining in price. And it is expected that this price will go still lower as such bonds are in direct competition with the Liberty bonds, and will of course be in competition with the further government bonds about to be issued.

There is one most important thing that must be borne in mind in connection with our government's huge war appropriations, and it is this: While these appropriations run into billions of dollars, we are the richest country in the world, and are amply able to provide the government with all the money it will need to make the world "safe for democracy." Nor must we forget that every bond issue will further stimulate business. The history of England and Canada proves this, for general business in those countries has grown by leaps and bounds since the war started. It is estimated that 80 per cent of the money raised by our government from taxation and bond issues will be paid out in the form of wages to the people of this country. Public utility securities are a favorable investment at this time.

Texas Power & Light Company, a subsidiary of American Power & Light Company, has sold $1,000,000 two-year 6 per cent secured gold notes to Harris, Forbes & Company and Coffin & Burr, Inc. The notes are dated September 1, 1917, and are secured by pledge of $1,389,000 face value of first mortgage 5 per cent bonds of the company. The total issue of notes authorized is $4,000,000, and the remaining notes can only be issued by pledge of bonds in the foregoing ratio.

Stockholders of Consumers Power Company, a subsidiary of Commonwealth Power, Railway & Light Company, at annual meeting held at Portland, Maine, on Tuesday, increased the authorized capital stock of the company from $22,000,000 to $40,000,000. The increased capital stock is divided into $10,000,000 preferred and $8,000,000 common stock. The new stock cannot be issued without authority from the Michigan Railroad Commission and then only for cash at par for improvements or additions to the property. Retiring directors were re-elected.

Report of Earnings.

GENERAL ELECTRIC COMPANY.

Gross earnings of the subsidiaries of General Gas & Electric Company for July were $249,556, as compared with $210,533 in 1916, an increase of $39,022.

EASTERN POWER & LIGHT CORPORATION.

Gross earnings of Eastern Power & Light Corporation for June were $377,391, as compared with $333,128 in 1916, an increase of $44,262.

EDISON ELECTRIC ILLUMINATING COMPANY.

The Edison Electric Illuminating Company of Boston reports for the month of July, gross earnings amounting to $662,281, an increase of 10.31% over July, 1916.

BRAZILIAN TRACTION, LIGHT & POWER COMPANY, LTD.

	1917.	1916.
June gross	*7,642,000	*7,178,000
Net after taxes	4,022,000	3,930,000
Six months gross	44,646,000	41,179,000
Net after taxes	24,402,000	23,021,000

*Milreis.

AMERICAN LIGHT & TRACTION COMPANY.

Reports for the first half of the current year show that the gross earnings of the American Light & Traction Company have increased 13.84 per cent for gas, 9.66 per cent in electricity and 21.50 per cent in street railways. Due to increase in operation, the company shows a decrease in net earnings of $496,505.

ALLIS-CHALMERS COMPANY.

Earnings of the Allis-Chalmers Manufacturing Company for the quarter ending June 30, 1917, compare as follows:

Sales billed:	1917.	1916.
April	$2,035,293	$1,434,779
May	2,176,752	1,733,015
June	2,229,529	1,938,336
Total	$6,441,574	$5,106,130
Net profits:		
April	$ 340,425	$ 291,486
May	356,624	327,912
June	305,406	331,363
Total	$1,002,455	$ 950,761

Unfilled orders on hand June 30, 1917, amounted to $16,564,842.

Copper Market.

The range of copper prices is slightly lower than that of a week ago. Lake is quoted at 28.50c to 29.50c, and electrolytic at 27c to 27.50c, for August deliveries. Quotations for September and October deliveries indicate a slightly lower tendency. Casting copper is quoted at 26c to 27c.

But quotations at present are not specially significant because of inactivity in the open market. Uncertainty prevails, awaiting the expected action of the Government in fixing the price it will pay for copper; and that price will be gauged by the cost of production, which has materially advanced within two years. Government inquiry into production costs is in progress. Thus, the weakness of the market reflects in no way the normal influences of supply and demand, but a status quo pending Government action.

It is admitted, generally, that copper reserves are low, and that just now production is considerably below producing capacities; and at the same time it is apparent that copper requirements for war munitions are heavy, while demands in the industries are not likely to diminish. These facts, together with the high costs of mining, smelting and refining, do not presage low prices; but Government price-fixing, based on costs, should stabilize and clarify market conditions.

A recent sale by producers of 50,000,000 pounds of copper, at around 25 cents, to the entente allies was arranged through the Council of National Defense, and had little, if any, effect on the general market.

WEEKLY COMPARISON OF CLOSING-BID PRICES OF SECURITIES OF LEADING ELECTRICAL COMPANIES.

Quotations furnished by F. M. Zeiler & Co., Rookery Bldg., Chicago.

Public Utilities—	Div. rate per cent.	Bid Aug. 7.	Bid Aug. 14
Adirondack Electric Power of Glens Falls, common	..	18	18
Adirondack Electric Power of Glens Falls, preferred	6	72	72
American Gas & Electric of New York, common	10+extra	110	110
American Gas & Electric of New York, preferred	6	47½	47½
American Light & Traction of New York, common	..	295	290
American Light & Traction of New York, preferred	6	108	107
American Power & Light of New York, common	4	67	65
American Power & Light of New York, preferred	6	87	85
American Public Utilities of Grand Rapids, common	..	27	28
American Public Utilities of Grand Rapids, preferred	6	64	63
American Telephone & Telegraph of New York	..	118½	120
American Water Works & Elec. of New York, common	..	7	6¾
American Water Works & Elec. of New York, particip.	7	21	20
American Water Works & Elec. of New York, first preferred	..	67	66
Appalachian Power of Bluefield, common	..	4	4
Appalachian Power of Bluefield, preferred	7	30	30
Cities Service of New York, common	6+extra	274	275
Cities Service of New York, preferred	6	84½	85½
Commonwealth Edison of Chicago	8	120	119
Comm. Power, Railway & Light of Jackson, common	4	48	48
Comm. Power, Railway & Light of Jackson, preferred	6	76	76
Federal Light & Traction of New York, common	..	12½	12½
Federal Light & Traction of New York, preferred	..	48	48
Illinois Northern Utilities of Dixon	6	75	77
Middle West Utilities of Chicago, common	2+2 extra	39	39
Middle West Utilities of Chicago, preferred	6	71	71
Northern States Power of Chicago, common	7	89	89
Northern States Power of Chicago, preferred	7	97½	97
Pacific Gas & Electric of San Francisco, common	5	54	54
Pacific Gas & Electric of San Francisco, preferred	6	88½	89
Public Service of Northern Illinois, Chicago, common	7	91	91¼
Public Service of Northern Illinois, Chicago, preferred	6	97	97
Republic Railway & Light of Youngstown, common	4	33¼	33¼
Republic Railway & Light of Youngstown, preferred	6	65½	65
Standard Gas & Electric of Chicago, common	..	10	10
Standard Gas & Electric of Chicago, preferred	6	35	35
Tennessee Railway, Light & Power of Chattanooga, common	..	5¾	5¾
Tennessee Railway, Light & Power of Chattanooga, preferred	6	30	30
United Light & Railways of Grand Rapids, common	4	40	39½
United Light & Railways of Grand Rapids, preferred	6	69½	70
Western Power of San Francisco, common	..	13	13
Western Power of San Francisco, preferred	6	54	54
Western Union Telegraph of New York	extra	93	93½
Industrials—			
Electric Storage of Philadelphia, common	4	59	59
General Electric of Schenectady	8	154½	154½
National Carbon of Cleveland, common	8	*76	79
National Carbon of Cleveland, preferred	..	130¾	*130¾
Westinghouse Electric & Mfg. of Pittsburgh, common	5+extra	49¼	48¾
Westinghouse Electric & Mfg. of Pittsburgh, preferred	7	65	65

*Last sale.